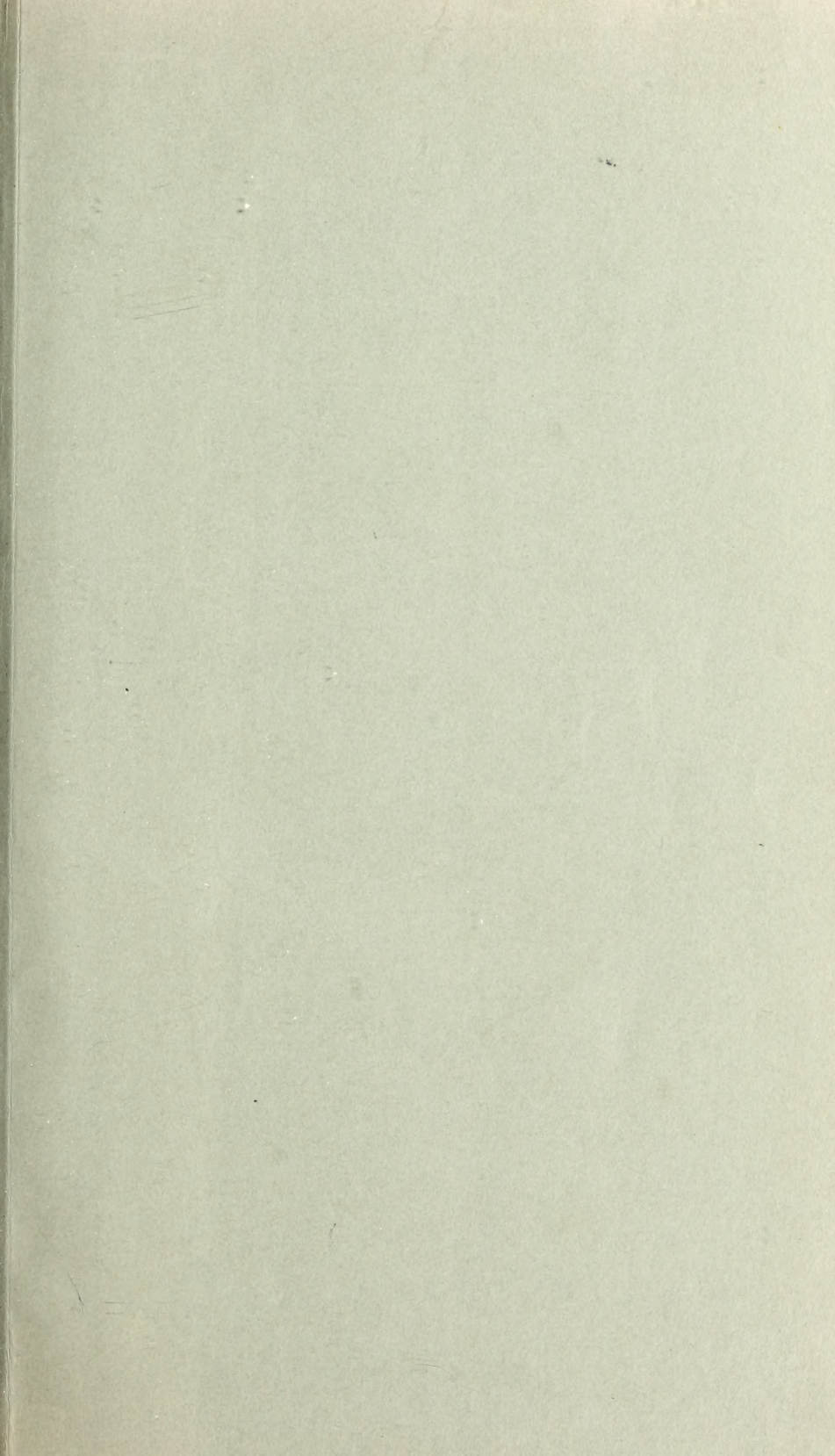


Clemson University

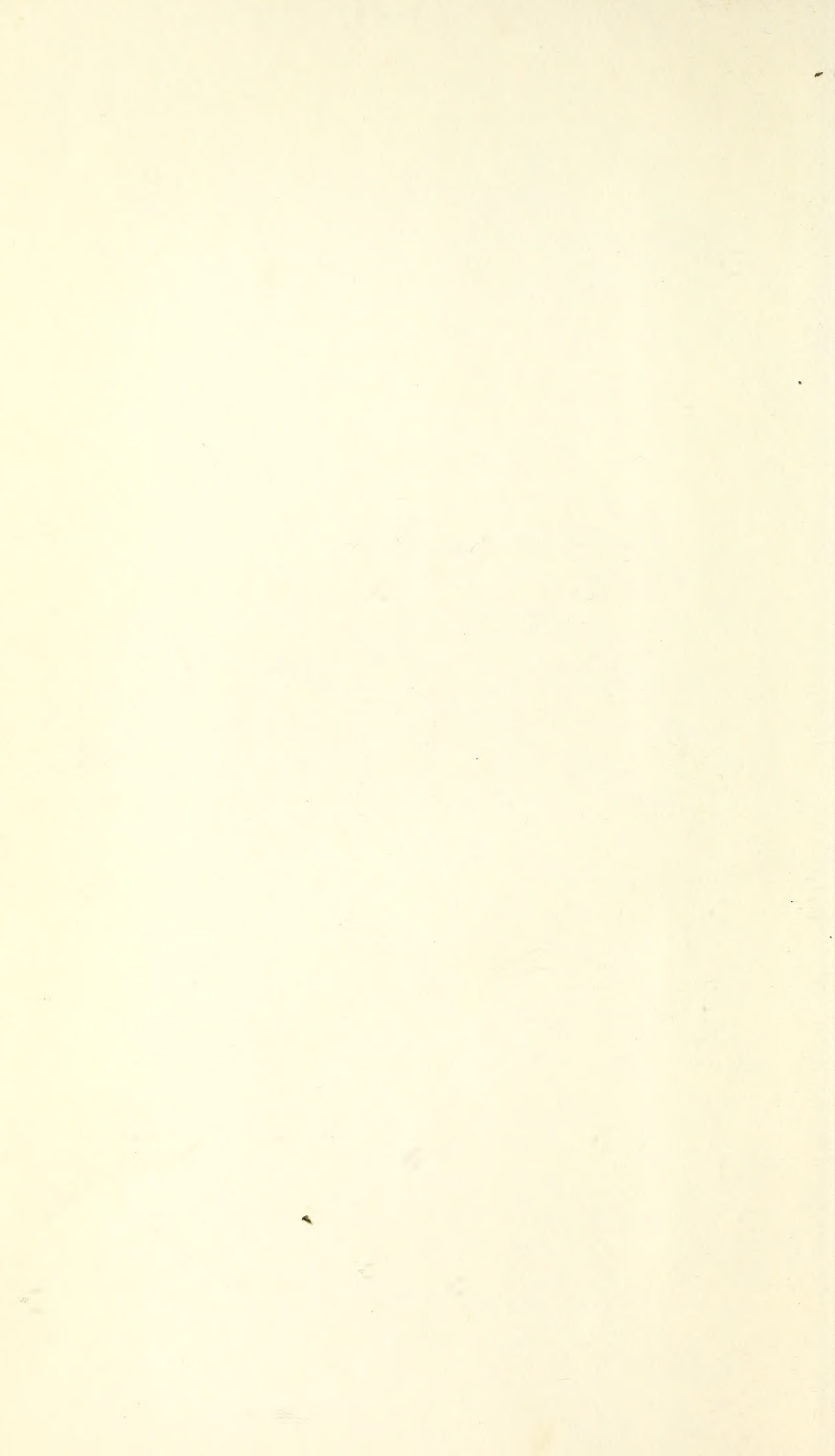


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REPORT OF THE FORESTER

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., October 11, 1926.

SIR: I have the honor to transmit herewith a report of the work of the Forest Service for the fiscal year ended June 30, 1926.

Respectfully,

WILLIAM B. GREELEY, *Forester.*

Hon. W. M. JARDINE,
Secretary of Agriculture.

FOREST LAND OWNERSHIP

Unstable forest land ownership is to-day the greatest single obstacle to the rapid spread of timber growing throughout the country. It is represented by the land speculator, or the lumber company which intends to dispose of its holdings when cut over, or the State without a policy of permanent forestry for its timberlands, or the State, county, or town which is anxious to have tax-reverted lands chiefly valuable for timber growing put back on the assessor's rolls. If all or most of the 470,000,000 acres of forest land in the continental United States—close to one-fourth the entire land area—were in the hands of owners whose future returns rested on actual use of the land, the Nation's forest problem would be much nearer solution.

There would still be necessary, of course, the prosecution of research on a large scale and over a long period to learn the best methods of growing timber and of utilizing what the forest produces—just as extensive and continued agricultural research is necessary for better and more profitable farming. In the case of timber growing, research must answer many riddles which now perplex and hold back the landowner. There would be necessary a large amount of educational work to make known the best methods and induce those who would profit by using them to undertake them. There would be necessary public facilitation of timber growing through the removal

of obstacles and economic handicaps, such as the risk of fire damage and of higher taxes than this form of land use can support. These are all essentials of an adequate public program of forestry. But so long as those who hold title to forest land are not interested in making or keeping it usable for timber growing, a fundamental obstacle remains.

CLASSIFICATION OF FOREST LAND ACCORDING TO OWNERSHIP

The ownership of our forest land is in round numbers as follows:

	Acres
Federal Government-----	89,000,000
States-----	10,500,000
Municipalities and counties-----	700,000
Private owners, large---	220,000,000
Private owners, small---	150,000,000

From the standpoint of stability, the holdings of municipalities, small private owners, and the Federal Government rate relatively high. State holdings vary from highly stabilized to wholly unstable. Large private holdings are in the main unstable, but with strong evidence of a trend toward greater stability. This trend constitutes the most significant feature of the present forest situation in the United States.

THE NEED FOR MORE PUBLIC OWNERSHIP

Ultimately it is probable that public ownership and stable management of

at least one-third of the total forest area of the country will be found advisable. Under the policies defined by the Weeks Act of 1911, the Clarke-McNary Act of 1924, and the forest exchange act of 1922, the present national forests should be consolidated, extended over the remaining public domain that is valuable chiefly for timber production, and enlarged, through purchase, in regions where serious forest denudation must be overcome or national interests like the conservation of water flow protected. It is not desirable, however, to purchase additional Federal holdings in regions where local needs can be met by State or municipal forests or by the extension of farm and industrial forestry.

State and municipal forest holdings are now far behind the extent desirable if not imperative in bringing general stability into our forest-land ownership as a whole. Since municipal (town and county) forests are not likely to contribute in the aggregate a large area to the public ownership of forest lands, it is to the extension of State forests that special attention and effort should be directed.

STABILITY OF FEDERAL HOLDINGS

The Federal Government now owns one-fifth of the forest land in the continental United States. Of this total about nine-tenths is under stable administration having definitely in view forest preservation and public use, in one form or another. This includes both national forests and national parks. In addition, forested portions of Indian reservations totaling close to 6,000,000 acres are under administration as permanent forest lands but without definite decision as between continuing Federal ownership or eventual disposal. Further, the act of June 7, 1924, made provision for acquainting Congress with the location of public lands suitable for adding to the national forests. On the whole, substantially all the forest lands now in possession of the Federal Government can be counted as reasonably sure to remain in stable ownership; and the same policy will be applied on all lands acquired by purchase hereafter.

STATE POLICIES OF FOREST LAND OWNERSHIP

In the adoption of permanent forest land ownership and land management most of the States are far behind the Federal Government. Of the

State-owned forest lands a little more than 5,500,000 acres, or 63 per cent, is under administration for public purposes, while nearly 5,000,000 acres more are either subject to private acquisition or being held without final determination of policy. Yet the States moved before the Federal Government to inaugurate public forest ownership.

In 1872 New York created a commission to consider State ownership of "the wild lands lying northward of the Mohawk, or so much thereof as may be expedient"; and the beginnings of the present Adirondack and Catskill forest preserves date from 1885. In 1876 Colorado became a State; its constitutional convention memorialized Congress asking for the transfer of the public timberlands in the Territory to the care and custody of the State, and its constitution provided that the general assembly should enact laws to preserve the forests upon the State's lands, or upon public domain lands placed under its control. California created a State board of forestry in 1885, which urged in its first report that all Government and State timberlands not fit for agriculture be permanently reserved and the cutting of timber placed in the hands of National or State forestry officers; and the legislature in 1888 passed a concurrent resolution praying Congress to stop the disposal of all Government lands in California with a view to their permanent preservation as a forest reserve for the protection of the watersheds of the State.

Other forms of State forestry legislation and activities began still earlier. Laws aimed at the control of forest fires had their historical antecedents in colonial times. Michigan and Wisconsin both inaugurated inquiries on their State forest conditions and needs in 1867. In 1869 the Maine Board of Agriculture appointed a committee to report on a forest policy for the State, and three years later a law "for the encouragement of the growth of trees" exempted from taxation for 20 years lands planted to trees. Laws offering tree planters either bounties or tax exemption were passed between 1868 and 1872 in Connecticut, New York, Minnesota, Wisconsin, Iowa, Missouri, Dakota, Nebraska, Kansas, and Nevada—all before the first Federal timber culture act. Forestry bureaus or commissions were inaugurated in a number of States in the eighties. These are examples merely.

It was the Federal act of 1891 authorizing the President to create for-

est reserves, the act of 1897 providing for the administration of these forests, their rapid upbuilding under President Roosevelt, and the inauguration in 1911 of the policy of land purchase to add to their number that has placed the Nation so far ahead of the States in permanent forest-land ownership and management. Coincidentally other forms of Federal activity in forestry have been greatly enlarged. Public attention has been centered on forest conservation as primarily a national problem, to a degree which has tended to place unduly in the background the concurrent need for more localized action and the nature of the immediate interest of each community, commonwealth, and region in permanent forest resources.

At the present time the policies of the various States with regard to forest-land ownership show the widest divergence. New York has over 2,000,000 acres (17 per cent of its forest land area) in State forests and parks, and is gradually adding more lands through purchase. It began withholding from sale tax-defaulted lands in the Adirondacks 43 years ago and in consequence had even at that time a nucleus of 600,000 acres toward the forest preserve. Pennsylvania has over 1,000,000 acres in State forests and parks and is contemplating extensive further purchases, likely to lead ultimately to State ownership of approximately 40 per cent of its forest land area. All three of the Lake States have large State forests, but none of them has adopted a clear-cut policy for holding tax-defaulted lands or timberlands received through Federal grants and consistently blocking them up into suitable administration units. Several of the far Western States have obtained or are now acquiring such units through exchanges of their scattered school lands within the national forests for solid blocks of timberland, and have in view permanent retention and management of these lands. All told, 29 States have either State forests or State parks; or both; but as yet only 8 States have as much as 100,000 acres so reserved, and 15 have less than 10,000 acres each.

State activities in forestry have, with a few notable exceptions, developed with other ends primarily in view than the administration of public forest properties. Usually State foresters have at first been appointed to serve as agencies of information, education, and advice to private owners. When administrative functions were added they generally concerned the

organization and maintenance of State systems of protection against fire. Through the enactment of the Weeks Law in 1911, providing for Federal cooperation with the States for this purpose, the protective work was greatly stimulated and enlarged. But the time has come for the States to grapple in earnest with that part of their problem which can only be met through public forest ownership.

The purchase policy of the Federal Government does not contemplate removal from the States of this duty of public forest management. It is intended to be cooperative in spirit and method: to seek common counsel with the States, and a correlation of Federal and State acquisition activities under a general program advancing all interests concerned. The public interests in forestry must be taken care of not as primarily a Federal matter, nor as primarily a State matter, but through a working partnership. This is in accordance with one of the basic principles which the Forest Service has always sought to apply, of avoiding undue centralization and of developing localized activities under a unified program.

The States have obtained their present forest lands partly through Federal grant, partly through tax default, partly through purchase and gift. A formidable obstacle to putting all their present holdings and additional lands reverting through tax default under permanent administration is the scattered location of a large part of these lands. In some States constitutional provisions also stand in the way. A further obstacle is the frequent lack of an administrative agency adequately organized and equipped to assure the consistent carrying out of a farsighted policy of land purchase and management. These obstacles must be overcome. The States, which began a half century and more ago to take thought for the preservation of their forest resources, should press forward to early assumption of their full responsibilities for forest-land ownership and management.

For this it is essential that the forest needs of each State individually receive the public attention that their importance deserves. The movement for a national policy of forestry has made gratifying progress. The same can not be said with regard to State policies of forestry in many instances. During the past year the Forest Service has sought to encourage localized effort for forestry, to increase the study of local problems, and to de-

velop local movements and leadership. It will continue and further emphasize this phase of its work.

FOREST POLICIES OF LARGE PRIVATE OWNERS

Unstable private ownership of forest land needs to be thoroughly studied. Present knowledge of its extent, the specific reasons for it, and what can and should be done to lessen it are inadequate. Economic conditions are tending to replace unstable ownership with stable, and both from this and from other causes the situation is changing—possibly faster than is recognized. Public policies can hasten or retard the rate of change. They should be shaped in the light of certain knowledge rather than surmise.

A great deal of the present instability of ownership is due to special conditions which make it impracticable for particular individuals to handle their forest properties as permanent investments. Obligations must be met, going operations carried forward, the capacity of established plants utilized, plans that have been entered upon put through, though this means stripping from the land all that can be manufactured and leaving it bare of forest capital other than the very smallest growth. Unquestionably also privately owned timberlands do not always afford sufficient prospects of financial return under permanent management to constitute a promising investment, at least under present conditions. The hazards arising from inadequate protection from fire or taxation systems ill adapted to timber culture are not infrequently genuine deterrents. On the other hand, failure to appreciate the economic trend of timber supply and timber values is often the reason why commercial timber growing is not undertaken on a much broader scale. To break down this obstacle is primarily a task of education and demonstration—in a broad sense, of salesmanship.

Not so long ago nearly all large private holdings of forest land were in unstable ownership, in the sense that the proprietors did not contemplate permanent retention of title. The changing attitude of the forest industries and timberland owners in this matter is very significant. The point of view of many lumbermen has been that they were engaged in an essential industry—the manufacture of lumber—which necessitated timberland ownership as the source of supply of raw material; that their busi-

ness was utilizing timber, not growing it; and that what might happen to the land after they were done with it did not concern them. That they should be regarded as destroyers instead of producers of wealth seemed to them a distorted, unfair, and monstrous idea. But what happens to the land is certainly of public concern. Open-minded lumbermen are coming to see that if they accept in good faith the idea of self-government in industry they must not ignore a public responsibility created by land ownership. While that is not a responsibility to engage in the business of timber growing as a permanent commitment against their will, nor a responsibility to sink money in unsound ventures, it does impose an obligation to weigh carefully, as business men, the methods of forestry. And that the lumbermen are increasingly ready to do.

In the South, particularly, an evolution appears to be taking place both in the attitude of timberland owners and in actual woods practice that is of very great import. Conditions in the South are peculiarly favorable to industrial timber growing—that is, to large-scale forest management designed to supply the needs for raw material of associated permanent industries. Classing with the South the border States of Maryland, West Virginia, Kentucky, and Missouri, this group of 16 States contains 48 per cent of the forest land in the entire country. Three-eighths of their total area is forest land. Relatively little of this will make agricultural land. Because of the rapid growth of timber in these States, the certainty of large markets relatively near or easily reached, and other advantages the opportunities for good returns on capital engaging in this form of enterprise seem exceptionally promising. The development of timber growing as a permanent land usage is fundamental to the future prosperity of the region, and hardly less important to the country at large.

Southern pine constitutes 70 per cent of the present lumber output of the region, and it is on the southern-pine land that the early introduction of timber growing is most urgent. If cut over without provision for obtaining regrowth and then left unprotected and uncared for, the pine lands decline in productive possibilities. The southern-pine forests also support the great naval-stores industry of the South and provide material for a growing pulp and paper industry.

Together, the lumber, naval stores, and pulp and paper industries of the South reported in 1923 products valued at more than \$760,000,000. All three industries are turning toward forestry as a means of providing for their future requirements. Nevertheless, to imagine that economic trends and private initiative will of themselves take care of the situation would be a serious mistake.

The South is decidedly behind any other part of the country in public provision for forestry, in public realization of its importance, and in the thought and customs of the rural population with regard to fire. Forest lands under public administration comprise all told less than 2 per cent of the forest area of the 16 States. This small fraction is made up of 3,291,000 acres of national forests, chiefly in Arkansas and the Appalachian Mountains; 61,000 acres of State forests and State parks; and some 83,000 acres of municipal and county forests. Less than one-fourth of the total forest area is receiving any degree of public protection against fire, and the combined expenditures of the States, the counties, private owners, and the Federal Government for protection are only about one-tenth the estimated cost of adequate protection. Thus public aid in timber growing is of the most meager character.

The task required to make the South safe for forestry is very great. Stable ownership of private holdings based on continuous use of the land can be largely accelerated through public action. The most important educational need is not merely to show timberland owners what they might do if they would, how to do it, what it would cost, and what returns an investment in timber growing might yield, highly important though this is; the people generally must be brought to realize what forestry requires of them, collectively and individually. Forest fires in the South are to a much larger degree than in any other part of the country deliberately caused, not the result of indifference or carelessness. They are the consequence of a deeply ingrained custom of woods burning. Traditionally, from the time of settlement, in most of the South livestock production has depended upon free range; and with the belief that fire improves the grazing the small farmers have been in the habit of burning the range—that is, the woods—annually. Thus there is an apparent conflict of interest between the local population and large timberland owners

who wish to obtain reforestation. Laws, as well as local custom and individual practices and habits, are involved. If the South is not to see almost one-half its land area failing to contribute adequately to the support of population and the maintenance of prosperity, the States must individually and vigorously develop the policies and create and support the organizations needed to protect their interests.

This holds true not merely for the South. A review of the salient facts for each forest region would make clear that with few exceptions the States have as yet not assumed the part which belongs to them. The spread of industrial timber growing as a permanent use of the 220,000,000 acres of land in the United States now in large private holdings depends to a very large extent on what the individual States do in promotion of their own interests in the matter.

A PROGRAM OF ACTION

A few years ago it was a moot question whether a sound public policy of forestry did not require the immediate adoption of measures to regulate forest utilization on private lands. That something needed to be done to substitute timber growing for destructive exploitation was widely recognized. Legislation was proposed looking to regulation by Federal authority. An alternative plan was also proposed for State regulation, to be stimulated by limiting Federal aid in fire protection to States which should adopt and apply adequate regulatory measures. After prolonged deliberation, Congress chose neither course but laid down, in the Clarke-McNary law, a Federal policy of liberal aid to States in fire protection and the promotion of farm forestry and of enlarged national forests. The law made provision also for a study of the problem of forest taxation, generally regarded by large timberland owners and lumbermen as one of the most serious deterrents to stable ownership and industrial forestry. Thus was definitely laid down a course which relies on voluntary individual action under public inducements and assistance along cooperative lines as the most practical means for advancing private forestry.

It should not be forgotten, however, that the policy of Federal cooperation with the States in fire protection adopted under the Clarke-McNary Act has thus far been but partially applied ow-

ing to the limited appropriations available for its execution. That policy contemplated, as a national responsibility, the assumption of a reasonable proportion of the cost of adequate fire protection by the Government—keeping in step with the assumption of the remainder of the burden by the States and private forest owners. In many instances the States and landowners have gone much further toward meeting their quota than has the Nation. In this respect action is lagging, and the vigorous extension of cooperative forest protection contemplated by the law is being partly postponed. A clear obligation rests upon the Federal Government to do its part as promptly as possible toward making the protection policy it has adopted fully effective.

Translated into a program, our progress in forestry involves two groups of public activities. One group seeks to discover and make known the best practices—research and extension. The other group seeks to discover and adopt such public measures as sound policy dictates for the removal of undue obstacles and handicaps.

Activities falling in the first group formed, prior to the transfer of administration of the national forests to the Department of Agriculture in 1905, the main task of the Forest Service. They likewise comprised virtually the sole duties of State forestry departments for a number of years. From 1905 to 1920, however, the energies of the Forest Service were of necessity concentrated primarily on the enormous task of getting the Federal public enterprise in forest administration on its feet. To a large extent the State forestry departments have been occupied since the enactment of the Weeks law in 1911 with the development of the administrative functions required for organized protection of forest lands against fire.

Forest administration is still far and away the leading activity of the Forest Service, and always will be. But if a true picture has been painted in what has been said above, an obvious conclusion is that educational work to induce forest landowners generally to take up timber growing where this is the best form of land use, research to discover the best practices and clear the path of removable obstacles, a continued and widened campaign to lessen the evil of forest fires, and general enlightenment on the facts basic to sound State policies of forestry, constitute the most important immediate public need.

To meet this need calls for carefully coordinated effort by all available agencies in a sustained drive under a common program. Especially it calls for united effort by the Federal Government and the State organizations. Forestry is both a national and a local problem, but even the national problem requires for its successful working out, a localized as well as general attack. Each State must have a flourishing forestry movement of its own, based primarily on its individual needs and directed to the realization of a program adequate to its specific situation.

To promote such coordinated effort and the development of a program of action that will enlist all available agencies most effectively, the Forest Service reorganized during the year its informational, educational, and cooperative activities to bring them more closely together and enable them to function as a unit for the extension of forestry, both public and private. The ultimate objective is to bring under permanent beneficial use for forest purposes all of the forest land in the country on which stable management has not begun. The immediately following sections of this report indicate more fully the situation and the program ahead.

PROGRESS IN STATE FORESTRY LEGISLATION

Although comparatively few of the State legislatures held sessions last year, a considerable advance was made in State forestry legislation. Mississippi created a State forestry commission with authority to appoint a State forester. Similar legislation was again proposed in South Carolina, Florida, and Arkansas but failed of enactment. Virginia created a commission on conservation and development, with power, under approval of the governor, to take over all of the State's forestry activities; and Louisiana enlarged her general forestry governing board to include a representative of those interested primarily in State parks.

New York made available a \$5,000,000 bond issue that had been approved by popular vote in November, 1924, for buying more land within the forest-preserve counties, and also included in the conservation fund over \$30,000 for the acquisition of nonagricultural areas outside of these counties, to be used, among other purposes, for demonstrating forest management. Massachusetts authorized additional

forest-tree nurseries. Louisiana appropriated \$1,000 to buy land for a State nursery or other forestry purposes, and also required that an average of two seed trees per acre for every 10-acre plot shall be left standing and unbled when timber is cut or turpented. Mississippi sought the encouragement of land-owners to leave one seed tree per acre; and also authorized private contributions to a State forestry fund with provision that 90 per cent of the amounts so received must be spent on the land of those contributing and as they direct for reforestation and protection purposes so long as in harmony with the reforestation practices of the United States Forest Service.

The same act authorized the acceptance of gifts of land up to 2 per cent of the area of any county for State forests, and gave consent to acquisition by the United States, through purchase or gift, of up to 25,000 acres for national forests. New Jersey increased from 2 to 10 cents per acre the amount of tax paid annually by the State to municipalities on account of State forests; and also passed a joint resolution endorsing the program of the department of conservation and development for the acquisition of not less than 200,000 acres of wild lands for State forests, and authorized an expenditure of \$250,000 for the purpose whenever made available through inclusion in an annual appropriation act.

New Jersey, Virginia, and Kentucky strengthened their laws for the control of forest fires. Washington, in addition to amending various fire provisions, authorized the director of the department of conservation and development to designate as an extra fire hazard any forest region particularly exposed to fire danger, and to make rules and regulations for its protection. Mississippi vested her State forester with broad powers for the prevention and control of forest fires.

New York enacted a new yield tax law which partly follows the lines of the three earlier acts—that it supercedes, and partly follows the lines of the Massachusetts forest-taxation law. Kentucky provided for classifying as Forest reserves privately owned tracts containing not less than 1,000 acres each and devoted to the growing of trees, which thereafter, as long as they remain so classified, are to be taxed on a valuation of not over \$2.50 per acre. The taxes when collected are paid into the State treasury to the credit of a forest-reserve fund. In

addition a 10-per cent stumpage or yield tax is imposed when timber is cut, one-half to go to the State and one-half to the county, to be distributed in the same manner as other taxes. As an offset for loss of current revenues from forest reserves, the counties receive a reduction of the amount due the State under the general tax laws, equal to the ad valorem tax annually assessed by the State upon such properties.

In California; Minnesota, Washington, and Louisiana important constitutional amendments concerning the taxation of growing forests will be voted upon at the general elections in November; and in Wisconsin a proposed amendment for a like purpose, which was adopted by the legislature in 1925, will come for approval before the legislature to be elected this fall. If so approved it will be voted upon by the people at the next election.

The above summing up of recent legislation by the States shows advance all along the line. This is especially marked in the strong trend toward giving reforestation a dominant emphasis, in the efforts to reduce fires, and in attention to the tax problem. With legislative emphasis plainly laid upon these three vital points it can not be doubted that the States are making real progress.

COOPERATION WITH THE STATES IN FORESTRY

Cooperation with the States under the provisions of the Clarke-McNary law, enacted in June, 1924, became effective on July 1, 1925. This law followed the recommendations made to Congress by the Select Committee on Reforestation, after its nation-wide survey of the timber situation. The law seeks to promote forest production on the 80 per cent of the total forest area of the country which is privately owned. It provides for formulation of the protective measures necessary to keep the forest lands in each State productive; for protection from fire of timbered or forest-producing lands or watersheds; and for the study of forest taxation. It stimulates farm forestry by making available forest tree seeds and planting stock as well as assistance in timber growing and the management of woodlands on the farms. In all of these the law authorizes and directs cooperation with the States. Its obvious purpose is to link the Nation and the States in a united effort to develop private timber-growing on the widest possible scale.

Forty-one of the forty-eight States, and the Territories of Hawaii and Porto Rico, are now cooperating with the Federal Government under one or more sections of the law.

The study of forest taxation contemplated by the law is still at an early stage. Details concerning what is being done will be found on page 42. Work under the other sections of the law calls for brief comment here.

STUDY OF PROTECTIVE REQUIREMENTS

Section 1 of the law authorized and directed the Secretary of Agriculture, in cooperation with the various States or other suitable agencies, to recommend for each forest region of the United States such systems of forest fire prevention and suppression as will adequately protect the forest lands. During the year the situation was canvassed to determine in a broad way the protective requirements of the several regions and to ascertain the attitude of the individual States. It is planned, following such investigations as may be necessary, to embody in brief publications specific discussions of the more important economic phases of the forest problem of each forest region, their relationship to fire control, and recommendations for permanent and adequate protection. The purpose of these publications is to make clear existing forest-fire control problems in order that the proper protective systems or measures may be developed and applied. Publications covering Idaho and Florida were prepared. In the Pacific Coast and Northwestern States committees representing the State forestry organizations, the lumber industry, timber protective associations, and other interested agencies will work out with the Forest Service the scope of the proposed publications and will cooperate in their preparation and distribution.

In the East the work undertaken is in the nature of a fact-finding survey for each State, conducted by the State forestry officials and the Forest Service. This survey aims to bring together in definite form all information bearing upon the various phases of forest-fire control. When assembled this information will constitute a reservoir from which material may be drawn for various State or State and Federal cooperative publications. At

the same time it will afford a basis for specific recommendations by the Forest Service in cooperation with the States regarding the adoption of measures necessary to meet each major protection problem.

Plans for formulating adequate protective measures in all other forest regions are well under way. In general the trend is toward State publications prepared in accordance with the ideas of all interested agencies as expressed through conferences or committees.

PROTECTION OF STATE AND PRIVATE FORESTS FROM FIRE

The Clarke-McNary law has materially increased the scope and effectiveness of the fire-control work in many of the previously cooperating States, and has stimulated new States to cooperate. During the year Missouri, Oklahoma, and Georgia qualified as cooperators. Cooperation with Mississippi became effective July 1, the necessary laws having been passed and funds appropriated at the last session of its legislature. The inclusion of these States marks notable progress toward the conservation of our national timber supply, since they are in important timber-producing regions and have an aggregate area of nearly 60,000,000 acres of forest land. Of the Southern States only South Carolina, Florida, and Arkansas have yet to pass the requisite legislation to qualify for cooperation. They will probably take action during 1927. Of the 39 States having important timber resources, 33 are now cooperating in the effort to provide adequate protection from fire to their 330,000,000 acres of State and private forest land.

A Federal appropriation of \$660,000, State funds amounting to \$1,800,000, and \$465,000 in private funds to be disbursed by the States or under their supervision were available for cooperative expenditure. Additional expenditures for forest-fire protection to an amount in excess of \$1,000,000 were made during the year by private owners or associations.

The allotments to each State during the past year, including emergency allotments to States that experienced unusually severe fire seasons, are shown in Table 1.

TABLE 1.—*Cooperative expenditures in fire protection and the distribution of forest planting stock under the Clarke-McNary Act, fiscal year 1926*

States	Fire protection				Distribution of forest planting stock		
	Federal	States	Private agencies	Total	Federal	State	Total
Maine.....	\$26,925.02	\$114,043.66	-----	\$140,968.68	-----	-----	-----
New Hampshire.....	7,329.97	25,988.11	-----	33,318.08	\$2,000.00	\$6,266.00	\$8,266.00
Vermont.....	5,129.32	6,403.70	-----	11,533.02	2,000.00	8,126.24	10,126.24
Massachusetts.....	14,630.00	58,267.16	-----	72,897.16	1,991.95	7,967.76	9,959.71
Connecticut.....	6,015.00	28,526.59	\$630.74	35,172.33	1,212.16	1,212.17	2,424.33
New York.....	29,391.73	170,144.20	-----	199,535.93	1,728.85	62,339.57	64,068.42
New Jersey.....	7,445.00	79,682.12	-----	87,127.12	319.00	320.00	639.00
Delaware.....	-----	-----	-----	-----	375.00	375.00	750.00
Pennsylvania.....	35,435.00	101,219.03	-----	136,654.03	1,919.57	60,001.68	61,921.25
Maryland.....	5,710.00	14,633.50	-----	20,343.50	1,593.47	4,159.16	5,752.63
Ohio.....	2,060.00	10,975.80	-----	13,035.80	2,000.00	13,892.24	15,892.24
Indiana.....	-----	-----	-----	-----	1,221.10	2,479.21	3,700.31
Virginia.....	27,240.00	24,261.16	4,860.60	56,361.76	1,000.00	1,053.14	2,053.14
West Virginia.....	12,950.00	24,283.83	10,886.93	48,120.76	-----	-----	-----
North Carolina.....	29,465.00	30,750.79	-----	60,215.79	1,256.98	1,256.98	2,513.96
Tennessee.....	18,500.00	16,839.52	1,660.48	37,000.00	-----	-----	-----
Kentucky.....	8,000.00	8,033.64	-----	16,033.64	1,981.34	2,972.01	4,953.35
Georgia.....	3,137.99	3,929.52	-----	7,067.51	-----	-----	-----
Porto Rico.....	-----	-----	-----	-----	2,000.00	12,911.49	14,911.49
Alabama.....	28,300.00	24,278.65	6,128.76	58,707.41	1,911.09	1,911.10	3,822.19
Louisiana.....	25,320.00	34,107.48	35,067.42	94,494.90	2,000.00	4,158.40	6,158.40
Texas.....	25,666.22	26,821.02	-----	52,487.24	-----	-----	-----
Oklahoma.....	1,551.37	1,551.38	-----	3,102.75	-----	-----	-----
Missouri.....	2,000.00	2,414.92	-----	4,414.92	379.72	379.74	759.46
Iowa.....	-----	-----	-----	-----	2,000.00	2,144.58	4,144.58
Michigan.....	48,310.00	206,003.74	-----	254,313.74	2,000.00	5,035.03	7,035.03
Wisconsin.....	23,750.00	26,083.21	-----	49,833.21	2,000.00	2,434.01	4,434.01
Minnesota.....	42,445.66	141,301.81	-----	183,747.47	430.00	430.00	860.00
Kansas.....	-----	-----	-----	-----	2,000.00	3,535.18	5,535.18
Nebraska.....	-----	-----	-----	-----	228.66	228.66	457.32
Colorado.....	-----	-----	-----	-----	1,404.36	1,592.84	2,997.20
North Dakota.....	-----	-----	-----	-----	2,000.00	3,314.84	5,314.84
South Dakota.....	110.00	4,226.96	-----	4,336.96	-----	-----	-----
Montana.....	14,807.96	15,412.40	-----	30,220.36	-----	-----	-----
Idaho.....	35,635.00	183,587.88	-----	219,222.88	280.00	280.00	560.00
Washington.....	33,220.00	88,198.94	77,242.90	198,661.84	1,273.10	1,351.85	2,624.95
Oregon.....	33,525.00	36,490.91	126,470.45	196,486.36	2,000.00	2,159.14	4,159.14
California.....	29,970.00	97,556.98	564.30	128,091.28	600.00	8,984.26	9,584.26
New Mexico.....	1,400.00	5,362.00	-----	6,762.00	-----	-----	-----
Administration and inspection.....	53,052.35	-----	-----	53,052.35	1,900.00	-----	1,900.00
Total.....	638,427.59	1,611,380.61	263,512.58	2,513,320.78	45,006.35	223,272.28	268,278.63
Forest tax studies.....	8,447.29	-----	-----	-----	-----	-----	-----
Unexpended balance.....	13,125.12	-----	-----	-----	4,993.65	-----	-----
Total appropriation.....	660,000.00	-----	-----	-----	50,000.00	-----	-----

Both the number of fires and the fire losses were materially lower in 1925 than in 1924. This was due partly to a somewhat more favorable season, but chiefly to greater educational efforts and the increased effectiveness of the fire-control organizations. During 1925, 86,000 fires burned over nearly 26,000,000 acres of Federal, State, and private lands, and caused a loss of timber and improvements to the value of \$28,000,000.

Slightly in excess of 90 per cent of the total number of fires were man caused. Incendiarism was again responsible for the greatest number of fires, followed in order by brush burning, smokers, railroads, lightning, campers, and lumbering.

The number of fires reported for 1925, the damage caused, and the area burned in the several forest regions are shown in Table 2.

TABLE 2.—*Summary of forest fire statistics, by groups of States, for the United States (exclusive of Alaska), 1925*

Group of States ¹	Number of fires		Damage		Area burned	
	Total	Per cent	Total	Per cent	Total acres	Per cent
United States (exclusive of Alaska).....	85,762	100.0	\$28,054,878	100.0	26,518,715	100.0
Northeastern.....	6,923	8.0	1,008,707	3.6	200,238	.8
Appalachian.....	5,087	5.9	1,485,971	5.3	448,291	1.7
Southeastern.....	33,610	39.2	15,182,598	54.1	13,599,688	51.3
East Mississippi.....	3,780	4.4	1,240,201	4.4	481,584	1.8
West Mississippi.....	19,776	23.1	4,905,944	17.5	9,779,767	36.9
Lake States.....	5,811	6.8	2,199,538	7.8	1,418,983	5.3
Rocky Mountain.....	4,038	4.7	753,743	2.7	160,304	.6
Pacific.....	6,737	7.9	1,278,176	4.6	429,860	1.6

¹ Northeastern group: New England States, New York and New Jersey.

Appalachian group: Pennsylvania, Delaware, Maryland, Virginia, and West Virginia.

Southeastern group: North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi.

East Mississippi group: Ohio, Indiana, Illinois, Kentucky, and Tennessee.

West Mississippi group: Missouri, Arkansas, Oklahoma, Louisiana, and Texas.

Lake States group: Michigan, Wisconsin, and Minnesota.

Rocky Mountain group: Montana, Idaho, Wyoming, South Dakota, Nebraska, Colorado, Arizona, New Mexico, Nevada, and Utah.

Pacific group: Washington, Oregon, and California.

COOPERATION WITH THE STATES IN TREE PLANTING

Section 4 of the Clarke-McNary law authorizes and directs the Secretary of Agriculture "to cooperate with the various States in the procurement, production, and distribution of forest tree seeds and plants, for the purpose of establishing windbreaks, shelter belts, and farm wood lots upon denuded and nonforested lands within such cooperating States." This section of the law was passed to meet a definite need. For a number of years a few of the States had extended assistance to landowners, and particularly to farmers, in reforesting cut-over lands and establishing and improving wood lots. These States established forest tree nurseries to provide planting stock. The demand for young trees constantly exceeded the supply; inadequate appropriations in most of the States limited expansion of the work; and the entire output of the nurseries permitted the planting of only a negligible acreage compared with the 80,000,000 acres of denuded forest lands in need of planting.

Experience has proved that the production and distribution of suitable trees for forest planting is not obtained without public assistance or guidance. The commercial production of such stock is undeveloped in most sections of the country. The State forestry departments and the Federal Government are showing the way by producing these small trees in quantity and at a minimum cost. Thus a de-

mand has been created which greatly exceeds the producing capacity of the State nurseries and which many private companies are now engaged in supplying to a limited extent.

The farmer can not afford to plant his waste lands unless the planting stock can be bought at a low figure. The purpose of the law is to enable him to get the kind and quantity of trees needed for his special uses at a cost which he can afford. Primarily as a result of the offer of cooperation, 14 new States have forest-tree nurseries in operation or in process of development. Thirty-three States and the Territory of Porto Rico are now cooperating, the Territory of Hawaii has indicated its desire to receive assistance, and certain additional States will undoubtedly request cooperation during 1927.

The allotments made to the States cooperating during the year are shown in Table 1.

COOPERATION WITH THE STATES IN FOREST EXTENSION

Under section 5 of the Clarke-McNary law the Secretary of Agriculture cooperates with the States or other agencies to assist farmers in growing timber crops and in other forms of farm forestry. The work in carrying out this provision of the law is conducted by the Extension Service of the department in cooperation with the Forest Service. It forms an essential part of the general program of national forestry.

For familiarizing farmers with forest practice and encouraging its adoption the outstanding agency is the State extension organizations created in conformity with the Smith-Lever Act. At the close of the fiscal year these organizations had forestry projects in 25 States. Participation of the State foresters in extension activities is also essential. The degree to which forestry can be extended as a farm practice depends in part upon what services are available from the State forester.

Employment by the State extension services of an extension forester is the first step in the development of definite States programs, covering "projects" on which information will be most valuable to the farmers of the State. For each project selected, a plan of work—that is, a method by which the specific information will be conveyed to those wanting it—is devised. These plans of work make it possible for the county agricultural agents and local leaders to enlist widespread interest in forestry as a phase of diversified agriculture.

Extension forestry projects are being developed for boys and girls. Among the projects of the past year those dealing with the planting of forest trees held a leading place. By far the largest results were achieved in the planting of cleared land in farm ownership but not suitable for cultivation. In many States these idle lands represent a burden of considerable magnitude. Of less importance in connection with future timber supplies, but closely related to farm prosperity, comfort, and attractiveness, is the planting of windbreaks or shelter belts about farmsteads and the establishment of roadside trees. These projects are being pushed in the Middle West and Great Plains region.

Throughout all of the States of the East and South farm demonstrations of the satisfactory care, improvement, and management of woodlands are being given. Closely associated with these demonstrations is the teaching of simple methods of measuring timber, the principles of timber and woodland marketing, and the prevention of damage to woodlands from fire, livestock, fungi, etc. The work has been heartily accepted in most of the States, and gives promise of development comparable with that of other projects in the agricultural extension programs.

EXPENDITURES AND RECEIPTS

The expenditures and receipts for all purposes during the fiscal year were as follows:

General administration----	\$376,988.97
Protection of the national forests:	
Fire prevention and detection-----	1,504,582.49
Fire suppression-----	1,263,899.29
Protection against insects and tree diseases-----	43,950.69
Total-----	2,812,432.47
Administration of current business on the national forests:	
Administration of timber use-----	960,225.44
Administration of grazing use-----	588,353.73
Fish and game protection-----	72,043.55
Administration of recreation and land use-----	104,272.27
Examination of power sites for Federal Power Commission--	35,159.79
Total-----	1,760,054.78
Surveys of lands and resources:	
General surveys and maps-----	134,027.95
Grazing reconnaissance-----	94,161.40
Timber surveys-----	225,816.85
Total-----	454,006.20
Land adjustment and extensions:	
Classification, settlement, and claims---	94,685.39
Land exchanges-----	136,933.52
Acquisition under act of Mar. 1, 1911, as amended-----	1,009,554.32
Total-----	1,241,173.23
Nurseries and tree planting	173,815.23
Tree planting in cooperation with States under act of June 7, 1924----	44,881.70
Construction and maintenance of improvements:	
Construction of improvements other than roads, trails, and camp ground improvements-----	615,091.99
Maintenance of improvements other than roads, trails, and camp ground improvements-----	529,314.56
Camp ground improvements-----	39,462.33
Total-----	1,183,868.88
Research:	
Silvical investigations	285,255.40
Forest products investigations-----	593,331.92
Range investigations--	63,791.29
Taxation study-----	8,447.29
Total-----	950,825.90
Fire protection in cooperation with States under act of June 7, 1924----	638,427.59
Protection of Oregon and California grant lands--	87,688.69

Road and trail construction and maintenance:	
10 per cent fund under act of Mar. 4, 1913-----	\$677, 935. 88
Cooperative construction of roads and trails under act of July 11, 1916-----	867, 101. 90
Federal forest-road construction under act of Feb. 28, 1919-----	33, 201. 81
Forest development roads and trails under act of Nov. 9, 1921-----	3, 393, 083. 08
Forest highways under act of Nov. 9, 1921-----	5, 059, 865. 44
Road and trail construction from moneys contributed by cooperating agencies under act of June 30, 1914-----	1, 581, 040. 62
Contributed from other appropriations-----	1, 392, 950. 83
Total-----	13, 005, 179. 56
Grand total----	22, 729, 343. 20

The above statement includes expenditures made by the Forest Service from Congressional appropriations and cooperative funds. It also includes expenditures made by the Bureau of Public Roads for the construction and maintenance of national forest roads.

National forest protection cost approximately \$1,000,000 less than the previous year, in consequence of a more favorable fire season; the smaller expenditures for suppression account for nearly all the reduction. An increase of about \$133,000 in the cost of administering current business was almost entirely due to greater timber-sale activity. On survey work, essential for better protection and use of all the forest resources, the expenditures were increased by about \$52,000. An enlarged acquisition program raised the outlay for land adjustment and extension more than \$200,000. Nurseries and tree planting (for national forest reforestation) showed an increase of 5 per cent, or a little over \$8,000. Tree planting in cooperation with States is a new item, representing the inauguration of this work under the Clarke-McNary law.

Improvements showed increased expenditures of approximately \$133,000. Cooperative fire protection was materially expanded, as a result of an increased appropriation, and the outlay for it rose \$245,000. Road and trail construction and maintenance took \$795,000 less. The grand total was almost \$1,030,000 less than that for the fiscal year 1925.

The road and trail expenditures, constituting as they do 57 per cent of the grand total, call for additional comment. The development of im-

proved highways, minor roads, and trails is an essential prerequisite of efficient administration, protection, and development of the forest resources. In part it is likewise essential to the carrying out of the general plan for a national system of highways. Appropriations are made by Congress in accordance with its recognition of this double need. The general plan of road development authorized and called for under the various laws is worked out by the Forest Service, with the cooperation of the Bureau of Public Roads and State and county officials. The construction of major projects is supervised by the Bureau of Public Roads but the actual disbursements are made by the Forest Service, which also handles the construction of minor roads and trails not calling for specialized engineering supervision. As a part of their regular duties many forest officers devote some time to minor road building and maintenance and to the construction of trails, all of which are vital to effective protection.

The time spent incidentally by guards, rangers, and other officers not paid from road appropriations is charged in the cost-keeping records against the road work of the service. This work is also charged with its proportionate share of general overhead costs, in the ratio which they have to direct expenditures on all classes of work in the field.

The receipts from the national forests were as follows:

From the use of timber----	\$3, 366, 685. 36
From the use of forage-----	1, 421, 588. 70
From miscellaneous uses, including the use of land, water-power sites, etc----	367, 386. 96
Total-----	5, 155, 661. 02

The total is greater by \$155,523.53 than that for the previous year. Receipts from timber increased \$426,292.06, while receipts from grazing decreased \$303,788.11. Receipts from miscellaneous uses rose \$33,019.58, mostly through more recreational permits.

The increase in timber receipts was due mainly to a greater cut in the three Pacific Coast States and northern Idaho, where the lumber industry is now drawing most heavily upon the national forests. Timber receipts tend to rise, but fluctuate from year to year in response to market demands for lumber and other products. The total for last year reached a new peak. It was nearly 11 per cent greater than in 1924, the previous high record. Since 1920—which was also a peak

year—the timber receipts have risen more than 66 per cent. In 10 years they have considerably more than doubled.

The decrease in grazing receipts was due almost entirely to the waiver of grazing fees in the drought-stricken regions of the Southwest under special authority of Congress. Conditions in the Southwest improved to such an extent in the spring and summer of 1926 that the payment of all grazing fees was resumed on October 1, 1926, and a substantial increase in grazing receipts is looked for in 1927.

NATIONAL-FOREST ADMINISTRATION

The national forests are no longer primeval solitudes remote from the economic life of developing regions, or barely touched by the skirmish line of settlement. To a very large degree the wilderness has been pressed back. Farms have multiplied, roads have been built, frontier hamlets have grown into villages and towns, industries have found foothold and expanded. Although the forests are still in an early stage of economic development, their resources are important factors in present prosperity.

The growing demand for the products of the forests makes skillful handling of the timber, range, and other resources increasingly important. To this need, and to the best way of meeting it, the thought of the entire organization has been strongly turned during the year. While successful handling of the forests demands also business and managerial ability, the care and development of the physical resources is the essence of the administrator's work.

Good physical resource management can not be worked at long range nor obtained by machine methods dictated from above. It must be developed on the ground, through the intelligent planning and individual skill and initiative of those in immediate charge of the properties. One of the needs is for enlargement of the capacity of the personnel for expert physical resource management through instruction and training. The effort to bring this about can not go faster than the requirements of good current work and available funds permit, and is kept within rather narrow limits by the necessity for the strictest economy in every direction. Nevertheless, under the pressure of necessity ways can be found, and are being found, to make some provision for progressive training of the field force.

Efficient management of the timber resource involves better fire control, with special attention to cut-over areas and old burns, a more effective attack upon destructive insects, a greatly expanded planting program, and simple management plans which fix the rate at which timber is to be cut, the location of cutting areas, and the methods of reforestation—all based upon the growing capacity of the forest land. In order to serve the public needs effectively the best practice in the utilization and conversion of national forest timber is sought, partly through the stipulations of cutting contracts and partly through educational methods, experiments, and demonstrations in connection with the research work conducted at the Forest Products Laboratory. A correlation or diversification of wood-using industries built around the raw material available in the national forests is unquestionably one important need. It is the logical supplement of our land-management policy of producing as much wood as possible.

In the development and management of range resources the essentials to be aimed at are stability in range allotments, the development of simple range management plans defining the objects sought on each unit and the specific things required to put them into effect, more effective range inspection, some increase in the number of technically trained grazing men, and the construction of range improvements to permit better range control and utilization.

In managing recreational uses on the national forests adequate funds to keep up with the growing public requirements for camp-ground improvements are seriously lacking. The handling of the water power, recreation, and wild life resources of the forests and their correlation with timber and range use are being provided for as well as possible by simple but definite planning. In the constantly increasing conflicts between two or more uses of the same area, the problem can be handled only by giving preference to the form of use to which the lands are best suited and by which the interest of the public will in the long run be best served.

A program for the next five years has been adopted, which provides for the making of timber-management plans for all working circles where the present or immediately prospective cut either approaches the probable sustained yield or involves an amount of timber or complexity of conditions

making necessary an analysis of the whole situation as a basis for orderly development; for the making of grazing-management plans for each grazing unit in use, based largely on data already obtained through range appraisal and in the course of administration; and for the completion of the plans necessary for the conduct of land exchanges. It is important that the resource plans be kept simple, adapted to the actual needs of administration, and free from refinements not justified by a common-sense dealing with existing conditions. Above all they must be such that the field force will thoroughly grasp and use them. As the individual resource plans are developed, needed points of coordination must always be watched for and dealt with.

ECONOMIES IN ADMINISTRATION

The consistent pursuit of economy has enabled the Forest Service to handle an expanding business at relatively small increased cost. The most fertile fields were personnel adjustments to accomplish more work with fewer employees, cooperation with other Government and outside agencies and individuals, the installation of mechanical devices and improvement in methods, reduction in paper work, and short cuts in business practices.

Vigilant care is given to keep the force employed in general administration in the Washington office at the smallest point consistent with the prompt and efficient handling of the business. It was possible during the year to make a redistribution of duties which released \$5,800 a year. In the field organization many adjustments were made which reduced the force. Consolidations of ranger districts and other field and office adjustments cut out more than 30 positions and saved approximately \$40,000. Considerable savings were effected by enlarging the mobility of the field force and flexibility of the organization to take care of special demands and peak loads. In one district \$9,200 was thus saved in timber surveys and timber-sale administration.

Cooperation with other Government and outside agencies brought about material savings. By borrowing an unused caterpillar tractor and a heavy grader from the county authorities the local forest officers completed a road in Colorado for \$5,000 less than the engineer's estimate of \$22,000. In Minnesota \$1,200 was similarly saved on a road project by securing a loan of county equipment and free services.

By enlisting the interest of local commercial concerns in road and trail projects of community benefit materials and equipments were in many instances purchased at reduced prices. These instances are illustrative of the economies, large and small, widely secured through cooperation.

In Alaska the cooperation between various Government and local agencies and the Forest Service is noteworthy. Valuable cooperation was given by the Bureau of Public Roads, the Geological Survey, the General Land Office, the Bureau of Fisheries, and the Department of Justice. An especially valuable form of cooperation is furnished by the United States attorney at Juneau, who acts as legal adviser to the service and thus takes care of work which in other districts is handled by assistants to the Solicitor of the Department of Agriculture.

The cooperation in Alaska is not one sided, however, the Forest Service reciprocating to the extent of its ability. It does a good deal of mimeographing without charge for the Bureau of Public Roads, the Alaska Railroad Commission, and other Government agencies not provided with equipment for such work. It is functioning as a central agency for purchasing certain supplies required in considerable quantity for the combined needs of the service and a number of other bureaus, thereby obtaining materially lower prices. It has made field surveys in southeastern Alaska for the Bureau of Education, for use in land withdrawals. The marine stations at Ketchikan have been utilized by the boats of the Bureau of Public Roads and the Geological Survey in making repairs. This mutuality of cooperation in Alaska is highly effective for economy of administration.

New applications of mechanical devices to construction work have enabled much more work to be done for the same money. An outstanding economy of this kind was accomplished by an increased use of horse equipment in trail construction. A side-hill plow and trail grader invented by one of our own men brought about an estimated saving of \$12,000, although the use of this device began only in midseason. A comparison of the 1924 and 1925 costs showed a reduction of \$100 a mile, and the construction mileage was doubled. The use in road construction of a dump truck which cost \$755, instead of horses and wagons, saved \$1,300 in the first season. Motor trucks have brought about a decided saving of time and funds in reaching fires and

handling equipment and have decreased the outlay for hired cars.

Short cuts in business practices and miscellaneous economies are continually sought for. By issuing grazing permits to livestock associations instead of to their individual members, as hitherto, one permit takes the place of from 100 to 200, with a corresponding decrease of administrative and clerical work. When possible district ranger meetings are held in mountain localities where the men can be lodged and subsisted at very small cost; on one of the forests the meeting was held at an Army post with no expense for lodging. In this way \$1,500 was saved in one district. A garage and storehouse were built by a ranger from materials salvaged from an abandoned mine building and enough lumber was left over to construct a fire-guard cabin to be built this year; the material salvaged would have cost \$400. Much ingenuity is displayed by the field officers generally in economizing time as well as meager allotments, producing savings individually small but amounting to worth-while figures in the aggregate.

These economies have to a limited extent made funds available for the most urgent requirements elsewhere. Through them it has been possible to add some new fire guards at weak points in the protective organization, provide salary increases for individual employees who are below the established rates or whose responsibilities are enlarged, do more to hold down man-caused fires through educational measures of various kinds, reduce the fire hazard by removing or improving dangerous conditions in the woods, build fire-control lines, improve sanitary conditions at public camp grounds, somewhat extend tree planting, and administer new timber sales. Had it not been for the leeway afforded by this means of financing added and imperative responsibilities, it is hard to see how serious breakdowns of efficiency and failures to meet public obligations could have been escaped. For every dollar, however, that can be saved through searching economies and through the ingenuity of the entire organization, there are several places clamoring for its expenditure on essential work. With the best done that can be done to stretch the available appropriations, the service is still far behind requirements.

NATIONAL FOREST PROPERTIES

At the close of the fiscal year the net area of the national forests was 158,-

759,210 acres, and the gross area, which includes all private and State owned land within the boundaries, 184,123,951 acres. The net area increased 364,154 acres, while the gross area decreased 1,961 acres, partly through area recomputations based upon more exact surveys and projections.

Additions totaled 69,672 acres. Acts of Congress added 19,905 acres to the Absaroka and 18,418 acres to the Gallatin, in Montana; 4,832 acres to the Washakie, in Wyoming; 2,103 acres to the Colorado; and 684 acres to the Rainier, in Washington. The last two additions were in the adjustment of national park and national forest common boundaries. Five additions, aggregating 23,730 acres, were made by Executive order or proclamation; the most important was an addition of 11,997 acres to the Shasta, in California, under special authority of Congress.

Eliminations totaled 109,775 acres, accounted for mainly by one of 68,160 acres almost all privately owned from the Angeles, in California, one of 7,059 acres from the Missoula, in Montana, and one of 28,059 acres from the Chelan, in Washington, this last being a clear listing of land selected under the State exchange.

PROGRESS IN LAND EXCHANGES

Consummated land exchanges added 14,230 acres to the net area. The Secretary of Agriculture approved and referred to the Secretary of the Interior 65 cases contemplating the receipt of 46,636 acres in exchange for 7,040 acres of land and 47,288,390 board feet of stumpage. Pending cases before the Department of the Interior at the close of the year numbered 83. Exchanges with the States of Washington, Oregon, California, Montana, and Colorado are progressing, and one with New Mexico is now in prospect. New land exchange measures enacted by Congress were: (1) Amendment of the New Mexico enabling act to allow a consolidation of State holdings within the forests; (2) authorization of the exchange of national forest lands or stumpage in Arizona or New Mexico for the forested parts of the Mora Grant in the latter State; and (3) authorization of an exchange for certain company lands in the Medicine Bow National Forest, in Wyoming, of an equal value of unappropriated and unreserved public lands in the same State.

The Forest Service has continued its conservative policy in land exchanges,

considering only cases of unquestioned public benefit and advantage.

PROGRESS IN LAND PURCHASES

In the East title was taken under the Weeks law to 174,711.14 acres, at an average cost of \$3.69 per acre, or a total cost of \$645,358.97. The National Forest Reservation Commission authorized purchases totaling 141,645 acres, with a valuation of \$687,409.57, or \$4.85 per acre. This is 9 cents below the average for all lands hitherto approved.

The distribution, by States, of the lands fully acquired under the Weeks law is shown in Table 3:

TABLE 3.—*Acreage of timberland acquired in the fiscal year 1926 and total acquired to July 1, 1926, by States*

	Acquired, 1926	Average price per acre, 1926	Total ac- quired to July 1, 1926
	<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>
Alabama.....	480.61	4.68	87,785.38
Arkansas.....	5,554.73	2.92	64,892.14
Georgia.....			159,978.84
Maine.....			32,255.98
New Hampshire.....	1,697.72	5.12	408,949.26
North Carolina.....	10,373.42	3.77	364,662.57
Pennsylvania.....	45,966.29	3.23	149,232.11
South Carolina.....	18,352.96	6.92	37,875.50
Tennessee.....	28,389.09	3.56	296,077.86
Virginia.....	60,289.99	3.11	563,927.87
West Virginia.....	3,606.43	4.22	222,731.11
Total or average.	174,711.14	3.69	2,388,368.62

The total cost of the lands fully acquired has been \$11,778,788.22, making the average cost per acre \$4.93.

No new purchase units were created, but the Youghiogheny unit of 80,259 acres located in western Maryland was abolished.

An addition was made to the Ouachita unit in Arkansas comprising 96,406 acres, of which about 2,800 acres are unreserved, unappropriated public lands. By recomputation the gross area of the Natural Bridge purchase unit was found to be 390,272 acres instead of 382,575 acres as previously reported. The present purchase areas contain approximately 9,146,143 acres. They include 921,699 acres reserved from the public domain, 11,369 acres transferred from the Treasury Department under a special act, and 2,722,885 acres acquired or in process of acquisition under the Weeks law.

Of the remaining 5,490,190 acres, 1,283,488 acres are known to possess

agricultural, mineral, or water-power values which preclude purchase. The net unacquired forest land in the existing purchase areas is therefore 4,206,702 acres. Some of it is held at prohibitive prices by the owners and some of it is already receiving such care and protection that there is no strong reason for public ownership. Approximately 390,000 acres are now under stable private management.

The year was noteworthy in that it marked the initiation of a program of national forest-land purchases in the Lake States, under the provisions of the Clarke-McNary Act. At its meeting of March 31, 1926, the National Forest Reservation Commission authorized the establishment of the Tawas purchase area, in Michigan, which embraces the Tawas and Mio divisions of the Michigan National Forest and contains a gross area of 616,960 acres, of which 84,860 acres is now in Government ownership; and of the Superior purchase area, in Minnesota, which embraces the Superior National Forest and contains a gross area of 1,628,118 acres, of which 806,681 acres is now Government owned. The commission also approved the purchase from the Michigan Agricultural College of 50,500 acres of land situated in the Tawas unit. Other areas in the Lake States, particularly the Oneida unit in northern Wisconsin and a unit in the upper peninsula of Michigan, are now under consideration as purchase areas.

No purchase units in the southern pine belt have as yet been submitted to the National Forest Reservation Commission, but at the close of the year a final check was being made upon a number of areas previously examined and tentatively selected, with a view to recommending one or more units.

The total of purchases under the Weeks law is now drawing measurably near to 3,000,000 acres of land, situated in 21 purchase units in 11 States. Acquisition of this land has been financially advantageous, while the collateral benefits have been many. It can reasonably be expected that future purchases will be equally advantageous. Federal leadership and participation in redeeming cut-over and denuded forest lands is a prime agency for promoting a sound policy both of public and of private forestry. Its expansion in its present fields and its extension into new fields is necessary as a means of further stimulating forest protection and the stable management of timbered lands.

The program called for is briefly: (1) The completion of the Weeks law forests, including new units in Kentucky and Missouri, through the purchase of an additional 4,000,000 acres at a cost of about \$25,000,000; (2) the acquisition of approximately 2,500,000 acres in the Lake States, at a cost of about \$6,250,000; and (3) the purchase of about 2,500,000 acres in the southern pine States at a cost of probably \$8,750,000. The complete program contemplates the placing under national-forest administration of 9,000,000 additional acres of forest land, much of it at present denuded and in poor condition, but with high potential values for timber production and stream-flow conservation, at a total cost of \$40,000,000.

The appropriation for the purchase of lands during the fiscal year 1927 is \$1,000,000. This is insufficient to permit maximum efficiency in purchase work or reasonable progress in the acquisition of the necessary lands. The National Forest Reservation Commission has for several years recommended appropriations of \$2,000,000 per year. The report of the Senate select committee set \$3,000,000 per year as the desirable minimum. The Woodruff-McNary bill, now before Congress, proposes \$3,000,000 per year for the first five years and \$5,000,000 for the next five. The several agencies suggesting these appropriations have given careful study to the requirements of the situation and have been conservative in the figures they recommend.

The purchase work should go forward along the lines planned, and rapidly. Delay will mean only increased costs and greater difficulty of consolidation. The perfection of an adequate system of national forests, appropriately distributed among the timbered regions of the country, is a pressing need.

SPECIAL USES

At the close of the calendar year 1925 30,801 special-use permits were in force, of which 16,220 were paid and 14,581 were issued without charge. The total receipts from special uses amounted to \$259,815.51, a sum greatly in excess of the costs of administration. These figures represent gains over the preceding year of 1,100 in total permits, 837 in paid permits, 263 in free permits, and \$30,579.79 in receipts. The principal uses continue to be hotels, resorts, outdoor camps, summer residences, drift and divi-

sional fences, pastures, reservoirs, and water conduits, but almost every conceivable form of land occupancy compatible with national-forest purposes is allowed. Although only a negligible percentage of national-forest area is occupied by these forms of use they serve large numbers of people in many beneficial ways.

COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

Proposals to add national forest lands to existing national parks, or to include them within new national parks, have created for the National Park Service and the Forest Service a common concern in the following projects:

Proposed additions and other boundary adjustments involving the Sequoia National Park, Calif.; Rocky Mountain National Park, Colo.; Mount Rainier National Park, Wash.; Grand Canyon National Park, Ariz.; Yellowstone National Park, Wyo.; Yosemite National Park, Calif.; Lassen Volcanic National Park, Calif.; and Crater Lake National Park, Oreg.

Proposed new national parks: Cliff Cities National Park, N. Mex.; and Mena National Park, Ark.

Through the agency of the coordinating committee on national parks and forests, mutually satisfactory boundaries were worked out for the Sequoia, Rocky Mountain, Mount Rainier, Grand Canyon, and Yellowstone National Parks. The new boundaries for the Sequoia and Mount Rainier Parks have been established by acts of Congress, and a partial adjustment of the boundaries of the Rocky Mountain Park has been similarly approved. Bills for the adjustment of the boundaries of the Grand Canyon and Yellowstone Parks are pending before Congress. The proposed additions to the Yosemite and Crater Lake National Parks were studied in the field by the coordinating committee last summer.

The proposed Mena National Park was examined jointly by representatives of the National Park Service and the Forest Service, who recommended against it. The proposed Cliff Cities National Park is still under consideration.

NORTHERN PACIFIC LAND-GRANT HEARINGS

The special joint committee of five Senators and five Representatives appointed under House Joint Resolution 183 of June 5, 1924, following the assertion by the Northern Pacific Rail-

way Co. of an alleged right to select 2,600,000 acres of national forest land, valued at approximately \$25,000,000, reconvened on April 14 and held hearings until June 29, 1926, when it adjourned for the summer. The hearings were a continuation of those held by the committee from March 18 to May 20, 1925.

A digest of the reports of the hearings, which contain over 5,000 pages of testimony, is now in course of preparation for the use of the committee when it reconvenes in December. The record seems clearly to support the

contention of the Forest Service that the railroad company has not complied with the terms of the land grants and therefore has no legal or equitable right to acquire the national forest lands it has proposed to select.

PROTECTION FROM FIRE

The number, size, and causes of fires on the national forests in the calendar year 1925, as compared with those of the previous year and the average of the past five-year period, are shown in Table 4.

TABLE 4.—*Comparison of fires on national forests, calendar years 1925, 1924, and 5-year average for period 1921-1925*

Classes and causes of fires	Number of fires			Percentages of total		
	1925	1924	Average 1921-1925	1925	1924	Average 1921-1925
Class of fire:						
Burns less than 0.25 acres.....	4, 531	3, 756	3, 363	54. 83	45. 54	49. 60
Burns between 0.25 and 10 acres.....	2, 264	2, 463	1, 898	27. 40	29. 87	27. 99
Burns 10 acres and over.....	1, 468	2, 028	1, 519	17. 77	24. 59	22. 41
Total.....	8, 263	8, 247	6, 780	100. 00	100. 00	100. 00
Causes of fires:						
Railroads.....	274	397	386	3. 32	4. 81	5. 69
Lightning.....	5, 001	3, 421	2, 850	60. 52	41. 48	42. 04
Incendiarism.....	894	1, 127	881	10. 82	13. 66	12. 99
Brush burning.....	214	309	262	2. 59	3. 75	3. 86
Lumbering.....	150	210	164	1. 81	2. 55	2. 42
Camp fires.....	664	876	1, 804	8. 04	10. 62	12. 61
Smokers.....	843	1, 551	---	10. 20	18. 81	---
Miscellaneous.....	223	356	433	2. 70	4. 32	6. 39
Total.....	8, 263	8, 247	6, 780	100. 00	100. 00	100. 00

Calendar year	Total area of national forest land burned over	Total damage of national forest land burned over	Total cost fighting fires exclusive of time of forest officers
1925.....	<i>Acres</i> 251, 102	<i>Dollars</i> 752, 851	<i>Dollars</i> 857, 516
1924.....	602, 044	1, 532, 100	1, 582, 792
5-year average, 1921-1925.....	373, 283	634, 528	755, 641

¹ Includes smokers' fires. Before 1922 camp fires and smokers' fires were classed together.

The number of fires in 1925 was practically the same as in 1924, but the acreage of national forest land burned over was 42 per cent less, the damage to the national forest resources 49.2 per cent less, and the total cost of fighting the fires, exclusive of the time of forest officers, 54 per cent less. There was a large preponderance of lightning fires and a marked reduction in the man-caused. The national forests of California,

Oregon, Washington, Idaho, and Montana had 69.5 per cent of all the fires of the year, and 83.2 per cent of the lightning fires. On these forests lightning caused 72.5 per cent of the fires and all other causes combined only 27.5 per cent. Man-caused fires on all the forests were 1,564 fewer than in 1924, a decrease of 32.4 per cent.

That the losses and costs of suppression were smaller, notwithstanding the virtually equal number of fires, was

largely due to better weather conditions. Early in the season severe drouth caused trouble in the Southwest, and in later months similar conditions were prevalent in Oregon, Washington, northern Idaho, and western Montana. On the eastern forests the fire danger was serious toward the end of the season. Nevertheless, the conditions generally were far more favorable than in 1924 and 1926.

As compared with the five-year period, fires caused by railroads were 29 per cent fewer, by brush burning 18.3 per cent, by lumbering operations 8.5 per cent, by campers and smokers 16.5 per cent, and by miscellaneous or unknown causes 48.5 per cent. Railroad fires were smaller as well as fewer; the companies as a rule diligently seek to prevent fires, and danger spots along their rights of way are being steadily lessened.

Incendiarism continues to be troublesome in isolated parts of the national forest regions, notably in parts of California, and in some of the forests in the southeastern States. Vigilance of patrol in danger seasons and strict law enforcement have done much to counteract the evil.

The vigorous campaign of prevention of campers' and smokers' fires bore fruit in 1925, with 920 fewer fires traceable to these causes than in the previous year, or 37.9 per cent, and 297 fewer than in the five-year period, or 16.4 per cent. In 1925 additional emergency restrictions were imposed by closing dangerous areas to tourists and campers and prohibiting smoking except in inhabited parts of many of the forests. The falling off in the number of these fires represents a considerably greater advance than the figures themselves indicate, for many more people were on the forests.

THE FIRE SEASON OF THE SUMMER OF 1926

The 1926 season has been exceptionally difficult. In the Southwest the spring rains were heavier than for several years, and the precipitation was normal in the Rocky Mountain and intermountain regions, but it was considerably below normal in the East, the Lake States, the Black Hills, and the States along the Canadian border and the Pacific coast. A prolonged drought in the early spring and summer resulted in bad fires on the Pisgah National Forest in North Carolina and the Monongahela National Forest in West Virginia, and many fires occurred on private holdings out-

side the forests, some of them causing serious losses. In May and June extensive fires burned on the Allegheny National Forest in Pennsylvania, two of these fires in June covering upward of 20,000 acres. In the Northwest fires started in April, and by the middle of May the season was well under way. Damaging fires occurred in Minnesota and on the Harney National Forest in South Dakota, one fire on the latter forest burning over 12,000 acres.

In May and June the forests in California and the North Pacific States suffered from many fires, and stringent restrictions on campers and smokers were enforced on forests where the danger was great. Early in July dry electrical storms caused a large number of fires in California, 65 on the Sierra National Forest starting from a single storm. By the middle of July the fire-fighting organization was taxed to its utmost in northern Idaho, western Montana, Washington, and Oregon. From July 10 to July 20 the number of fires in Montana and northern Idaho was 413. The Kaniksu and Pend Oreille National Forests suffered most. On July 6 lightning storms set 72 fires on the Kaniksu National Forest alone, and on July 12 upward of 150 fires were again started by lightning on this unit.

At the same time large fires were burning on the northern tier of forests in Washington, and the gravity of the situation was greatly increased by the exhaustion of the local labor supply in the northern Rocky Mountain region. Troops were obtained from Fort Missoula to help fight a large fire on the Blackfeet National Forest in Montana, and from Fort George Wright at Spokane to assist on the Kaniksu National Forest, on the line between Idaho and Washington. At the end of July 3,000 men were fighting the fires in this district, and many forest officers experienced in handling fire crews were drawn from other districts in which the situation was less dangerous. Most unfavorable conditions continued in early August, with the lookout service largely blinded by smoke, the weather exceptionally hot and dry, and high winds fanning the flames and causing a rapid spread of the fires on a number of the forests.

In Washington and Oregon conditions of great severity also prevailed. As in Montana and northern Idaho a scourge of lightning fires descended in July, starting in ten days 319 out of 397 fires. Early in August 37 large fires were burning on 12 forests, and

in the next ten days 183 new fires started, of which 140 were man-caused. At the close of this period 1,000 fire fighters were contending with 45 large fires, on 17 of the 22 forests in the two States.

About the opening of August the situation in California which had been very critical in the northern part of the State, improved somewhat, but soon became alarming again, with high temperatures and low atmospheric humidity. Many fires started on the Klamath, Shasta, Trinity, Plumas, Tahoe, Stanislaus, Sierra, and Sequoia National Forests. The initial spread of the fires was exceptionally rapid, and very large fires also developed on outside lands which had to be fought on an enormous frontage as they approached the national forests. Thousands of acres of national forest lands were burned over, and the losses of private owners were still larger. Happily, the long period of unrelieved drought and hot, windy weather which made the season so severe throughout the Pacific Northwest and northern Rocky Mountain regions was broken immediately after the middle of August by rain, and thereafter the problem of control was free from abnormal difficulties in those regions.

Five of the 21 years since 1905 have been very bad fire years. The first and on the whole the worst year was 1910, when more than 4,000,000 acres of national forest land were burned over. In that year the fire-fighting expenditures were \$1,150,000. In 1919 they were \$3,000,000, but the 6,800 fires burned over only 2,000,000 acres. Preliminary and incomplete figures for the present year place the total cost of fire fighting at \$2,250,000 the number of fires at 6,229, and the area burned at 704,000 acres. In area lost 1926 stands fourth among the five worst years. Yet in one respect at least it outdistanced any other year. It was the worst lightning-fire year ever known.

The unexampled losses of 1910 were due to furious winds which in northern Idaho and western Montana developed into a hurricane. This came late in a very severe and prolonged fire season, when many large fires were burning, the woods were exceedingly dry, and the energies of the Forest Service were already taxed to the uttermost. At that time the service had neither experience in handling emergency conditions nor organization, equipment, and means of communication and transportation necessary to

carry on a difficult and shifting campaign in the heart of great wilderness areas; and a national disaster followed.

In 1919 a season worse than that of 1910 in every respect except the culminating wind attack found the service vastly better prepared to fight the fires. The outstanding characteristic of that season was its extraordinary length combined with its severity. Both the losses and the expenditures were very heavy, but no catastrophe developed; and valuable experience was gained. Each year of such experience has made the defense stronger against the next attack.

But the attack shifts. It came this year in the form of a tremendous and unparalleled bombardment of the forests over a very wide area by dry electrical storms, at a time when the inflammability of the forests was exceptionally high. The result was to overwhelm the protective force at some points. In the main, however, the defense held.

The season, with its early beginning, was for a considerable time of first-class severity as a result of no rain, abnormally dry air and soil, and often strong winds. Such a season means many fires, for they start with the utmost ease; and they spread very rapidly.

The main problem of fire control relates to Forest Service districts 1 (Montana and northern Idaho), 5 (California), and 6 (Oregon and Washington). The five States named contain almost three-fifths of all the timber standing in the United States. All have normally a long summer period of exceedingly light precipitation during which the surface vegetation and forest soil become dry. In all of them the forests are mainly in mountainous regions, which make it hard both to get to fires quickly and to fight them successfully. And in all of them lightning fires are major menace. It is in these districts, in short, that fire control is most crucial and most difficult.

In all three the winter snows were much lighter than usual. In California particularly there was a cumulative deficiency of moisture because of 10 preceding dry years. Everything worked together, therefore, to create high inflammability at the time that the main attack of lightning suddenly broke.

It came between July 1 and July 20. For the most part the storms were unaccompanied by rain. In four

northern California forests 145 lightning fires were started about July 15. In the Washington and Oregon forests 484 lightning fires occurred between July 1 and July 12, mainly if not wholly in consequence of two extraordinarily severe dry electrical storms on July 5-6 and July 11-12. The same storms swept across Montana and northern Idaho.

The forests which suffered worst were those forming the northern fringe; and the Kaniksu National Forest in Idaho was hit hardest of all. The 72 fires started on July 6 were all detected, reached, and brought under control by the local protective forces—guards, smoke chasers, and trail crews. This was a remarkably good record when the demands made upon a limited number of men by so disconcertingly many calls at once are borne in mind. Control of the last of these fires was completed by July 11. Then came the bombardment of July 12—the most severe lightning discharge ever seen in this region. All along the Canadian border, in Montana, Idaho, and Washington fires were set.

The known number on the Kaniksu exceeded 150. Cases were observed in which, within 100 yards of the tree from which the fire spread, 8 or 10 other trees were shattered. One ranger district had 16 fires that night, all of which were promptly reached and put out. But another ranger district had 60. It was impossible to fight all the fires at once. Partly because of low visibility due to smoke, partly because of a place of origin not fully commanded from the lookout stations, some gained headway undiscovered. Later they spread, driving back the forces gathered to hold them, until they swept over the sites of fires that had been subdued; or they united one with another. Of all the fires started, only 32 failed to be brought under control by the local protective organization; but aided by a week of "fire weather"—that is, days of exceptionally low humidity and high winds which on July 18 developed into a gale—these relatively few unsubdued fires became conflagrations. The fight against them necessitated the largest concentrated organization and supply of men, subsistence, tools, and motor-truck and pack-train transportation ever thrown into a single field by the Forest Service.

At the maximum more than 1,400 men were employed. Forty officers were drawn from other forests, and 100 separate camps were established first and last. A total of more than

500 miles of trenches was built. Often laboriously established fire lines were lost because the wind carried high over them burning brands and sparks from which spot fires were started in their rear; sometimes the lines were broken by crown fires in a frontal assault; sometimes they were outflanked. On steep mountain sides ignited material often rolls or drops far down the slopes, starting new blazes as it goes; this was in some cases the reason for the escape of fires started by the lightning storms of July 12, after their control was nearly established.

The battle on the Kaniksu was more than a month long. On the evening of August 16, when only 4 of the 32 great fires were not under full control and safe except in the contingency of extremely heavy winds, rain came.

The Kaniksu has a total area of 444,686 acres of Government-owned land and a gross area of 657,620 acres. The fires covered 110,000 acres of Government land and 44,000 acres of private land within the forest, or not quite one-fourth of the gross area. Though the loss was so great, it was not a barren victory that was already practically won when the rain began to fall on the evening of August 16; for without the long fight against great odds not much of the forest would now be unburned. It must not be forgotten, however, that such fires mean the wiping out of the results of many successful smaller battles of former years, and of the young forest growth on reforesting old burns; nor that a few more battles of the same magnitude on the same forest would leave little to be fought for.

In the results obtained in California the picture brightens. As has already been indicated, the season there was one of unusual severity. The effects of unfavorable weather conditions this year were intensified by the cumulative effects of 11 dry years in succession. With the forests so highly inflammable fires got under way very fast. Frequently the flames covered from 1,000 to 4,000 acres before the first sundown, yet were under control by morning. One fire outside the Sierra National Forest ran over 8,000 acres the first afternoon. All told the outside fires probably covered at least 1,000,000 acres. A single one was reported at 85,000 acres, and another at 65,000. The great difficulty of holding in check such enormous fires as they sweep on toward the forest boundaries is obvious. Nevertheless the

entire area of national forest lands burned over in California was less than 190,000, or a little less than 1 per cent.

Out of 1,362 fires reported, of which 510 were lightning fires, largely bunched, 74 per cent were confined to an area of less than 10 acres. Relatively few fires required protracted campaigns to suppress. Fine cooperation was given by the lumber companies, most of which effectively enforced fire precautions; and there were few serious lumbering fires. A greater degree of public cooperation for fire prevention was given than ever before; and in southern California large contributions from public agencies and other local sources increased materially the degree of protection afforded the forests south of the Tehachapi.

In district 6 (Oregon and Washington) the area of national forests burned over was 121,051 acres, or 0.53 per cent. For all districts the area was 722,810 acres, or 0.46 per cent.

AIR PATROL

Airplanes were used in California, Oregon, Washington, northern Idaho, and western Montana. With the exception of some weeks of patrol over the Klamath National Forest in California because of an incendiary outbreak, regular patrol was not carried on but the planes were held in readiness for reconnaissance of large fires, the confirmation of reports of fires concerning which it was difficult to obtain reliable information from other sources, and flights after lightning storms and when the atmosphere was too smoky for the effective detection of fire by observers on the ground. A new use of the planes developed in 1925 was in transporting materials and dropping them where needed on the actual fire lines.

Five bases were used during the season—Mather Field and Glendale Park in California; Eugene in Oregon; and Vancouver and Spokane in Washington. The airplanes were furnished by the Air Service of the Army, and the pilots and mechanics were employed by the Forest Service. With the cooperation of the liaison officer detailed by the Air Service and a number of Air Service officers in charge of reserve officers' squadrons in the Army Ninth Corps Area the pilots were selected from reserve-officer candidates; the mechanics were obtained from a select list of ex-Air Service enlisted men with extensive experience in keeping up the type of planes used.

Officers and employees of the Forest Service acted as observers as necessity arose.

The number of flights made for fire protection, exclusive of test flights, engine-change trips, and transfer of planes, was 429, and the aggregate flying time was 905 hours. This considerable amount of flying was done without accident to personnel, although four of the planes were put out of commission temporarily by forced landings and landings on rough ground.

The Secretary of War has indicated the inability of the War Department to furnish airplanes for the work of fire patrol next year. If this activity is to be continued after the close of the present fire season, apparently arrangements must be made to handle it on a commercial basis. The appropriation for this purpose does not admit of the purchase of the number of machines indispensable to effective patrol, and indeed the Forest Service could not afford to own its own planes for the comparatively short period during which it needs them.

PREDICTION AND STUDY OF FOREST FIRE WEATHER

Based upon studies of "forest fire weather," the Weather Bureau has begun predicting the occurrence of dangerous conditions, and last summer provided in the Pacific coast and northern Rocky Mountain regions special warnings of hazardous weather. This fall the service will be extended to the Lake States and Northeast.

The forecasts are sent to all forest agencies, published in the local daily press, and released by radio. They are being carefully followed by timber owners and operators. When critical conditions are indicated patrol forces are increased, additional lookout men are placed at points of vantage, fire crews are held in readiness, and in some cases logging operations are entirely suspended. Many timber operators have installed radio sets at their woods camps so that they may receive these weather predictions with the least possible delay.

Through advance notice of forest-fire weather fewer man-caused fires can be expected, in spite of the increased hazard which attends greater use of the forests. To make its forecasts more accurate and of the greatest possible benefit, the Weather Bureau in cooperation with the Forest Service, State foresters, conservation associations, and other organizations is establishing numerous additional

observation stations. On many logging operations recording hygrothermographs are watched by the rank and file of woods workers with interest. Much of the time and funds of the forest experiment stations is being used to study the factors which contribute to the occurrence and increase the rate of spread of forest fires, the measures necessary to prevent and suppress fires, and the damage that fires do. Studies are under way to determine just how humidity, temperature, wind, and dryness of the forest fuels affect the fire situation. At several of the experiment stations the moisture content of duff is being studied through the use of the duff hygrometer developed at the Forest Products Laboratory. Throughout the entire West the lookouts on the national forests are studying the path and progress of each lightning storm that we may learn how to use the approach of these storms as an indication of the measures called for.

OTHER FIRE STUDIES

Similarly the records of thousands of fires are being analyzed each year to discover the causes which lead to catastrophes and to aid in procuring better forest-fire organization and control. These studies supplement the constant and determined pursuit of improved technic of fire fighting, more effective field organization, better preparation of personnel through special training, and every other practical phase of the combat. Year by year the efficiency of the protective system maintained by the Forest Service is being increased. It will never be possible to eliminate fires as a formidable enemy of the forests, nor to reach the point at which in exceptional years major conflagrations may not occur, as they may occur in cities; but the fire problem is being steadily reduced to smaller dimensions through energetic attack upon it from all angles and with all the power that the organization can bring to bear.

REQUIREMENTS FOR REDUCING LOSSES

Efficient and economical protection demands preparedness and vigorous effort to cut down the number of fires that start and to detect, reach, and put out those that do start in the shortest possible time. The present provision of funds for fire control does not make for economy. It tends to augment both the final actual expenditures and the property losses suffered by the

Government. When emergency conditions become acute practically unlimited funds become available for fire fighting. The Forest Service is expected to spare no effort to bring bad fires under control. The deficiencies thus created are laid before Congress, which has never failed to relieve the shortage through deficiency appropriations.

On the other hand, the preliminary organization, equipment, and measures necessary to prevent fires, to check them on discovery, and to control them within narrow bounds are limited by specific appropriations which are inadequate. Increase of these appropriations is one of the most imperative needs confronting the Forest Service.

Experience has proved conclusively that fire-fighting expenditures and fire losses can both be materially reduced by measures of prevention and preparedness of the following order:

1. Educational work among local residents directed toward the elimination of specific local causes of man-set fires.

2. A vigorous enforcement of anti-fire laws.

3. The removal of recognized hazards such as road-side slashings and other accumulations of inflammable debris.

4. Various means of "fireproofing" the woods, such as the construction of firebreaks or rudimentary fire lines, which may quickly be widened when fires have to be fought, and the felling of snags or dead trees when they form exceptional hazards or stand along strategic lines of fire control.

5. Adequate fire-suppression equipment of demonstrated merit, such as hand and gas pumps and fire trucks ready for emergency use.

A rapid completion of lookout towers and telephone lines to facilitate the most speedy discovery and initial action on fires.

7. A strengthening of the protective organization through more rangers, fire dispatchers, and patrolmen at points now known to be weak.

The resources available for these common-sense measures of preparedness are now seriously inadequate. The service is throwing into them all the funds that can be pared off from other activities. Its field officers are coping with one critical fire emergency after another with unexcelled loyalty, determination, and physical endurance under most trying conditions. But its efforts to protect the vast public property entrusted to its charge will

never be fully availing until much more liberal provision is made for the basic work of protection needed along the foregoing lines.

PROTECTION FROM INSECTS

There are some losses from tree-killing insects every year in all coniferous forests. Occasionally the insects become unusually abundant locally, and instead of killing only an occasional weakened tree infest large groups of valuable mature timber. Bark beetle epidemics of this sort have to be met by felling the infested trees and peeling or burning the bark. This prevents the emergence of new broods. Though only a part of the infested trees are reached, any large reduction in the local beetle population gives help to the natural enemies of the pest and tends to reestablish normal conditions.

The fight in previous years against the bark beetles on the Kaibab National Forest in northern Arizona apparently had this effect. The infestation there has subsided, and no work was necessary during the year. Another epidemic on the Lincoln National Forest in New Mexico appears to be breaking up from natural causes, after millions of board feet of pine timber had been killed; but the decline is slower than if funds had been available to combat the infestation. In California, strong colonies of insects are causing considerable loss in valuable pine timber in private ownership near or within several national forests, but during the year actual control work was limited to a small cooperative project in the southern part of the State, where the owners gladly joined in the effort.

The breaking up of the Kaibab infestation made available funds with which to begin work on two serious epidemics in Montana. One of these was in a valuable western white-pine stand on the Kootenai National Forest, about 20 miles from the Canadian border. It is too early to speak confidently of the results of this work, but it is believed that the epidemic was checked. The other Montana infestation was in the lodgepole pine on the Bitterroot and Beaverhead National Forests, on both sides of the continental divide. On the east side of the divide the beetles were establishing strong colonies and killing groups of from 2 to 50 trees in a place. The chief effort of the year was to treat these groups, and so to prevent further loss in the valuable timber on the watershed of the Big Hole River.

On the west side of the divide, on the Bitterroot National Forest, limited funds permitted work on only a small part of the infestation. It is planned to attack the infestation there vigorously in the spring of 1927.

The cordial cooperation of the Bureau of Entomology continued. This cooperation not only included the identification of insects and the giving of advice on the technic of control operations based on the habits and life history of the particular insect involved but also the joint study of insect infestation conditions on a number of national forests. Particularly valuable help was given by the bureau in the effort to lessen the damage from tip moths in the plantations on the Nebraska National Forest.

TIMBER

The cut of timber exceeded any previous year and totaled the equivalent of 1,192,000,000 board-feet, or 170,000,000 board-feet more than in 1925. It was the third successive year in which the national forests have furnished over 1,000,000,000 feet "for the use and necessities of citizens of the United States." For 20 years the increase in cut has averaged between 8 and 10 per cent annually. Contracts made or pending give ground for the belief that this average will hold for the next 5 or 10 years, though with fluctuations.

As has been urged in previous years, expanding timber sales necessitates a larger force of men competent to handle them if cutting is not to injure the forest and if a sustained yield is to be assured. Expert selection and designation of the part of the stand to be harvested and expert supervision of the cutting operation is essential. Competent scaling of what is cut is likewise essential; the scaling determines the receipts. The making of timber sales is still handicapped by inadequate funds. To handle properly a larger volume of business will require increased provision for meeting the expenditures involved.

The increases in cut are neither an indication nor a product of a commercialized administrative policy. The forests are not being managed primarily to put as much money as possible into the Public Treasury. Receipts are not swollen by offering bargains in stumpage, nor is timber forced on the market regardless of consequences to the trade or possible resulting waste in utilization. On the contrary, the essence of the policy is the largest public advantage.

This is not always clearly understood. The growth of the national forest timber business is sometimes regarded askance. It has been held to menace the orderly utilization of the country's timber supplies and has been attributed to a desire to make the forests self-supporting as soon as possible, without regard to the consequences. To clear up these misapprehensions it seems best to restate the main purposes governing the disposal of timber.

National forests are by law established to "improve and protect the forest, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of the citizens of the United States." Administrative regulation of their occupancy and use is governed by the principle promulgated by the Secretary of Agriculture under authority of the same law, that "all land is to be devoted to its most productive use for the permanent good of the whole people * * * and where conflicting interests must be reconciled the question will always be decided from the standpoint of the greatest good of the greatest number in the long run." Public management of the timber resource and disposal of its products seeks therefore continuity of production, permanence of supplies, and maximum of public benefits.

It follows that a commercialistic policy having in view primarily the balance sheet is impossible. On the other hand, financial considerations can not be ignored. The burden which the forests impose on the taxpayer should be made no heavier than is necessary to fulfill their purposes; they should become self-supporting when this can consistently be brought about; they should be developed in response to public needs; and those who use their products for commercial gain should pay the public a fair market value for what they take from the forests.

Careful appraisals, based on analysis of costs of production and selling value of the product, precede the offering of the timber and assure the receipt of a fair value for the property. Appraisal is prescribed by law. In all sales of more than \$500 worth of stumpage this appraisal is supplemented by advertising for competitive bids. Except for the so-called "cost sales" to homestead settlers and farmers for use on their own places, Congress has itself laid down the policy that requires purchasers to pay the

going market value of all timber sold. But in deciding where to offer stumpage, and in what quantity, the primary consideration is the maintenance of industrial stability, permanent establishments, and permanent and prosperous communities, not volume of cut and larger receipts.

Most sales are made to supply going enterprises. Sawmills and other wood-manufacturing plants, railroads requiring ties, mines needing timbers and lagging, and farmers who must have fencing material for their fields and fuel for their homes are examples. The increasing volume of sales is largely due to the fact that local exhaustion of private timber has compelled existing establishments and industries in many instances to turn to the national forests for continued supplies. To assure full utilization of the present supply along with proper provision for the growth of a new forest crop in its place, purchasers are required to cut in accordance with carefully framed provisions, to use specified methods of logging, to employ safeguards against fire, and to take only marked or designated timber but also to take all that is so marked or designated.

Wherever the amount of timber available and other conditions permit, sales are carefully adjusted to assure continuous and permanent supplies to all existing establishments dependent upon the national forests for their stumpage. In some cases, however, the national forest timber is so intermingled or so combined in natural logging units with privately owned timber that to obtain its economical utilization and market value it must be logged at the same time, even though a subsequent continuous supply adequate to maintain permanently the mill at its present capacity can not be provided. The salvaging of fire-killed or otherwise rapidly deteriorating timber also sometimes necessitates a local cut in excess of what can be obtained as a sustained yield.

In some regions a reduction in the milling capacity to balance the growth of timber is inevitable. In a few cases the establishment of new mills on a permanent basis is desirable as fast as there is a sound economic basis for their development and in these regions sales are encouraged, under reasonable terms. This benefits the communities through pay rolls, better transportation, increased taxable resources, and return to the counties of 25 per cent of the receipts. For example, the availability of national for-

est timber for paper mills in Alaska will result in the establishment of desirable new industries in that Territory. A large sale made a few years ago in eastern Oregon has already brought the extension of a common-carrier railroad to a town which lacked good transportation facilities, and will greatly improve local economic conditions through the presence of a large sawmill. Such cases are not numerous, and each is studied for its business soundness before action is taken. They are part of the general policy of using the resources of the national forests as they are needed to promote permanent prosperity and to meet real needs.

The lumber sawed annually in the United States averages about 35,000,000,000 board-feet. National forest logging operations supply the logs for less than 2 per cent of this lumber production. The national holdings contain the less accessible timber. They offer opportunities for mills to continue in business after their private timber is exhausted, and the public is thus protected against a shortage of timber to the extent that continuous output from the national forests permits. At the same time, the conservative sale policy in effect, including

the careful appraisal of all timber before its sale, gives the private owners of stumpage full opportunity to liquidate their holdings without unfair competition from Government timber. Sales after appraisal and advertisement tend to establish fair prices for private stumpage in regions where previously the owners of small tracts had no basis of comparison in selling their stumpage.

A sale of 193,000,000 board-feet of saw timber on the Modoc National Forest in California was widely advertised and a bid for it received from a company which is just completing its cutting under a contract on another national forest. The advertisement of 68,000,000 board-feet on the Colville National Forest in eastern Washington brought competitive bids from established operators in the region. At the close of the year, 1,750,000 ties on the Bighorn National Forest in Wyoming and 60,000,000 board-feet of saw timber on the Sitgreaves National Forest in Arizona were being advertised. Bids were received in both cases before the advertising period ended.

Tables 5, 6, and 7 summarize the national forest timber business for the calendar year 1925.

TABLE 5.—Quantity and value of timber sold, calendar year 1925

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>			
Alabama.....	68,000		68,000	\$180		\$180
Alaska.....	53,149,000		53,149,000	91,256		91,256
Arizona.....	442,924,000	306,000	443,230,000	1,205,504	\$241	1,205,745
Arkansas.....	5,308,000	116,000	5,424,000	29,159	116	29,275
California.....	229,005,000	2,143,000	231,148,000	533,053	1,252	534,305
Colorado.....	52,529,000	763,000	53,292,000	141,259	691	141,950
Florida.....	2,072,000		2,072,000	10,221		10,221
Idaho.....	195,938,000	3,740,000	199,678,000	561,722	3,469	565,191
Michigan.....	526,000		526,000	744		744
Minnesota.....	10,447,000		10,447,000	31,050		31,050
Montana.....	38,562,000	4,262,000	42,824,000	102,814	4,454	107,268
Nevada.....	1,618,000	200,000	1,818,000	1,745	210	1,955
New Hampshire.....	3,883,000		3,883,000	16,496		16,496
New Mexico.....	14,372,000	1,292,000	15,664,000	30,593	498	31,091
North Carolina.....	15,243,000		15,243,000	99,158		99,158
Oregon.....	385,982,000	2,600,000	388,582,000	788,735	1,509	790,244
Pennsylvania.....	30,000		30,000	430		430
South Dakota.....	17,867,000	783,000	18,650,000	68,923	867	69,790
Tennessee.....	10,340,000	114,000	10,454,000	17,117	140	17,257
Utah.....	13,853,000	874,000	14,727,000	27,731	956	28,687
Virginia.....	9,063,000	13,000	9,076,000	35,923	20	35,943
Washington.....	237,746,000	192,000	237,938,000	567,154	110	567,264
West Virginia.....	1,361,000	5,000	1,366,000	6,583	5	6,588
Wyoming.....	11,191,000	1,051,000	12,242,000	28,058	932	28,990
Total, 1925.....	1,753,077,000	18,454,000	1,771,531,000	4,395,608	15,470	¹ 4,411,078
Total, 1924.....	1,313,510,000	19,744,000	1,333,254,000	3,243,040	17,695	² 3,260,735

¹ In addition, minor products not convertible into board feet were sold; value, \$12,146.

² In addition, minor products not convertible into board feet were sold; value, \$19,229.

TABLE 6.—Quantity and value of timber cut under sales, calendar year 1925

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>			
Alabama.....	2,000		2,000	\$22		\$22
Alaska.....	57,525,000		57,525,000	99,715		99,715
Arizona.....	47,971,000	339,000	48,310,000	108,375	\$290	108,665
Arkansas.....	15,217,000	26,000	15,243,000	109,230	26	109,256
California.....	238,857,000	1,737,000	240,594,000	697,185	1,009	698,194
Colorado.....	53,644,000	700,000	54,344,000	148,070	700	148,770
Florida.....	1,343,000		1,343,000	5,889		5,889
Idaho.....	144,186,000	3,777,000	147,963,000	678,561	3,446	682,007
Michigan.....	367,000		367,000	458		458
Minnesota.....	6,428,000		6,428,000	25,331		25,331
Montana.....	49,363,000	3,511,000	52,874,000	115,221	3,711	118,932
Nevada.....	1,474,000	193,000	1,667,000	1,573	192	1,765
New Hampshire.....	8,312,000		8,312,000	44,556		44,556
New Mexico.....	23,477,000	514,000	23,991,000	41,421	474	41,895
North Carolina.....	6,186,000		6,186,000	20,629		20,629
Oregon.....	226,979,000	2,306,000	229,285,000	626,589	1,492	628,081
Pennsylvania.....	770,000		770,000	1,170		1,170
South Dakota.....	30,442,000	686,000	31,128,000	117,315	733	118,048
Tennessee.....	7,032,000	42,000	7,074,000	15,075	64	15,139
Utah.....	6,485,000	669,000	7,154,000	11,948	765	12,713
Virginia.....	6,431,000	19,000	6,450,000	28,256	34	28,290
Washington.....	154,910,000	192,000	155,102,000	235,801	124	235,925
West Virginia.....	379,000	8,000	387,000	932	8	940
Wyoming.....	79,688,000	980,000	80,668,000	187,641	930	188,571
Total, 1925.....	1,167,468,000	15,699,000	1,183,167,000	3,320,963	13,998	¹ 3,334,961
Total, 1924.....	1,075,509,000	17,769,000	1,093,278,000	2,935,823	15,786	² 2,951,609

¹ In addition, minor products not convertible into board feet were cut; value, \$4,769.² In addition, minor products not convertible into board feet were cut; value, \$14,074.

TABLE 7.—Number of timber sales, classified according to amount of sale, calendar year 1925

State	\$100 or under			\$101 to \$500	\$501 to \$1,000	\$1,001 to \$5,000	Over \$5,000	Total
	Commercial	Cost	Total					
Alabama.....	13		13					13
Alaska.....	270		270	55	17	7	2	351
Arizona.....	913	147	1,060	3	1	3	4	1,071
Arkansas.....	34	41	75			1	2	78
California.....	566	376	942	18	6	16	14	996
Colorado.....	642	165	807	28	2	11	3	851
Florida.....	111		111			1		112
Idaho.....	755	1,093	1,848	29	7	18	10	1,912
Michigan.....	31		31	1				32
Minnesota.....	68		68	3	3	3	3	80
Montana.....	600	981	1,581	31	4	7	4	1,627
Nevada.....	112	75	187	1				188
New Hampshire.....	147		147			2	1	150
New Mexico.....	751	333	1,084	8		7		1,099
North Carolina.....	257		257	9	1	3	2	272
Oregon.....	404	471	875	38	12	4	9	938
Pennsylvania.....				2				2
South Dakota.....	267	122	389	6	4	12	5	416
Tennessee.....	295	44	339	1	2	1		343
Utah.....	293	427	720	7		2	1	730
Virginia.....	323	16	339				5	344
Washington.....	169	57	226	9	4	5	6	250
West Virginia.....	22	3	25	3		1		29
Wyoming.....	222	232	454	8	1	1	1	465
Total, 1925.....	7,265	4,583	11,848	260	64	105	72	12,349
Total, 1924.....	7,525	5,498	13,023	126	61	101	71	13,882

TIMBER PLANTING

Table 8 shows by States the acreage planted on the national forests in the calendar year 1925.

TABLE 8.—*Planting on national forests by States, calendar year 1925*

State	Area planted
	<i>Acres</i>
Michigan.....	3,311.50
Idaho.....	3,279.00
Washington.....	1,776.00
Nebraska.....	1,105.91
Minnesota.....	894.00
Colorado.....	478.65
Montana.....	342.00
Oregon.....	221.00
North Carolina.....	75.00
California.....	37.00
New Hampshire.....	18.50
West Virginia.....	13.70
Total.....	11,552.26

In addition 4 acres in North Carolina and 9 acres in California were sown, bringing the total area covered by measures of artificial reforestation to 11,565.26 acres. The total area needing artificial reforestation is estimated at 2,000,000 acres.

The contrast between the two totals is in itself more eloquent of the disproportion between the effort to reforest and the area standing idle and destined to stand idle indefinitely unless artificially restocked than any comment can be. Past reports have repeatedly stressed the inadequacy of the reforestation work. Public criticism of the insignificant rate of progress toward restoring denuded lands to productiveness where natural regrowth can not take place within a reasonable period is rising, and is well founded. The Government is failing to do on the public properties expressly devoted to timber production and watershed protection what the plain logic of the general situation calls for as an extensive practice throughout the country.

The outlay so urgently needed to put the national forests where they should be in this matter in reality would be not an expenditure in the ordinary sense, but an investment. The private owner of timberland on whom is urged a measure of public responsibility for so handling his land that it may continue to produce may well ask what particular obligation he is under to invest his own money in this way, if the deforested public

holdings are to be kept idle for decades awaiting the necessary appropriations to give them value. The figures show that at the present rate it would take over 170 years to cover the land now awaiting the planting crews.

In point of fact even this showing of progress is a deception. One year's fires such as swept the West last summer add new areas calling for reforestation more extensive than the gain of a series of years. Further, under its policy of acquisition the Government is increasing the area in need of planting.

During the year the National Forest Reservation Commission approved the purchase of 50,000 acres of land for addition to the Michigan National Forest under the program for the enlargement of the Federal forests in the Lake States contemplated by the Clarke-McNary law. Title to this land is expected to pass to the United States before the end of the present calendar year. Repeated fires have destroyed the tree growth on about half of this land, so that it can be restored to productivity only by planting. The area to be planted on this forest is thus increased from 50,000 acres to about 75,000 acres. As other similar areas are purchased, each will add to the planting task.

In the Lake States planting can be done more cheaply per acre than in any other national forest region; a larger proportion of the trees planted live; and growth is very rapid. The nearness of the region to the center of population assures a strong market for the products. The present annual rate of planting on the Michigan National Forest is from 3,000 to 4,000 acres.

So long as the appropriation for planting remains unchanged, no increase in the scale of operations in Michigan is possible without discontinuing the work already under way in some other forest region, with the attendant losses in nursery equipment and experience in the work; and the reforestation projects which would be abandoned are almost as urgent and promising as in Michigan.

Similarly, the continuation of the purchase program in the Appalachian region and the creation of national forests from military reservations in the eastern United States have put under national forest administration about 100,000 acres of land now unproductive in regions where the de-

velopment of new timber resources is particularly urgent, but with its present resources the Forest Service is unable to cope with the problem of establishing tree crops on bare portions of these areas except on an experimental scale. These eastern forests should be demonstrations of profitable timber growing available to private citizens, municipalities, and States instead of setting a bad example by comprising in part unproductive land. They are capable of growing valuable pine, spruce, and hardwoods such as black walnut, tulip poplar, and oak. Their location in a region from which the virgin forests have been removed and into which lumber is now shipped increasingly from the Pacific coast makes it the more desirable that every acre should be growing as much timber as it can. On the more mountainous of these eastern forests, such as the Monongahela National Forest in West Virginia, the restoration of a forest cover by planting is also necessary for the beneficial effect on stream flow, the prevention of erosion in the mountains, and the safeguarding of water-power developments and navigation.

The increase in the rate of planting in Michigan to at least 6,000 acres annually and on the eastern forests to at least 5,000 acres annually should no longer be delayed.

RANGE

GENERAL CONDITIONS

Forage and range conditions during the fiscal year 1926 were generally good. The winter of 1925-26 was mild and the ranges were open to stock nearly the whole season. Hay was plentiful and stock of all kinds came through in first-class shape. The spring was somewhat cold and late in some sections, but except in a few spots in the Northwest the early summer was one of the best for the stockmen in many years. This was especially true of the Southwest.

The earlier years of drought and hardship had cut down the breeding stock and the 1926 range calf crop will probably not average much above 35 to 40 per cent. This means of course a shortage of steers two years from now, a situation which has stiffened prices for cattle of all kinds. The sheep industry reacted slightly from 1925, but lambs and wool brought fairly satisfactory prices. The 1926 lambing season was uniformly fine and the lamb crop unusually large.

USE OF THE RANGE

Table 9 shows the number of stock grazed on national forest ranges, by States. For purposes of comparison, the total of each class of stock grazed is shown for 1925, 1924, and 1912.

TABLE 9.—Grazing permits issued and number of stock grazed, calendar year 1925

State	Horses, cattle, and swine				Sheep and goats		
	Permits issued	Number of stock grazed			Permits issued	Number of stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Alabama.....	3	68					
Alaska.....	1						
Arizona.....	1,325	251,240	2,909	321	115	273,073	627
Arkansas.....	34	1,006	4	10	2	7	
California.....	2,171	162,785	5,670	270	355	409,730	4,469
Colorado.....	3,473	290,289	6,087		726	895,490	569
Florida.....	19	742		11	2	499	7
Idaho.....	3,163	136,760	9,267		902	1,337,941	88
Montana.....	2,119	131,142	10,112		437	558,320	75
Nebraska.....	30	9,045	389				
Nevada.....	441	61,187	2,587		100	302,861	
New Hampshire.....	24	153	16				
New Mexico.....	1,722	101,335	2,509	129	325	206,326	13,777
North Carolina.....	255	823	28	52	17	133	
Oklahoma.....	67	2,824	613				
Oregon.....	1,401	107,222	5,784	10	432	627,864	183
South Dakota.....	625	23,822	2,211		12	14,158	
Tennessee.....	22	137	2		3	44	
Utah.....	5,255	130,431	4,806	25	1,904	718,075	
Virginia.....	117	1,207	1		5	180	
Washington.....	615	21,602	1,089		137	171,421	
West Virginia.....	36	298	23	18	51	1,412	
Wyoming.....	887	104,824	3,797		310	644,729	
Total 1925.....	23,805	1,538,942	57,904	846	5,835	6,162,263	19,795
Total 1924.....	25,286	1,664,087	58,184	1,560	5,694	6,301,308	29,068
Total 1912.....	21,188	1,403,025	93,343	4,330	5,313	7,467,890	83,849

Since 1918, the peak year of war production, the trend in numbers of stock using the forests has been steadily downward for all classes of stock. The war-emergency conditions were met by admitting more stock than the ranges could permanently carry. Reductions to prevent overgrazing after the war ended, together with the adverse conditions of recent years through which the livestock industry has passed, have lessened the total volume of grazing on the forests from 1918 to 1925 by about one-fourth. The general liquidation in the livestock business has, in the judgment of experts, about reached bottom, and it is believed that the number of stock grazed next year will show a substantial upward trend.

Table 9 shows that in 1912, when the industry was about normal, the ranges carried 98,000 less cattle and horses than in 1925, but 1,373,000 more sheep. Since 1912 a country-wide decline in the number of sheep has taken place. While the number on the national forests has declined, the sheep permittees in 1925 numbered over 500 more than in 1912, and 134 more than in 1924.

The decline in the number of sheep since 1912 has been in the flocks of large owners. The number of persons allowed to graze in excess of 4,000 sheep fell from 290 in 1912 to 254 in 1925, and the total number of sheep permitted these owners fell from over 2,000,000 to less than 1,700,000. At the same time the number of permittees grazing not more than 1,000 head increased from 2,640 to

3,621, and the number of sheep permitted them increased from about 1,115,000 to more than 1,250,000.

Last year the Idaho forests had 1,337,000 sheep on them, and Colorado came second with over 895,000. In cattle Colorado led with over 290,000, Arizona following next with over 251,000 head.

Owing to the general depression in the cattle-raising industry and the recovery of the sheep business many national forest cattle permittees desired to change their herds to sheep. Such requests have been approved wherever possible; but in some instances a shift from cattle to sheep has appeared inadvisable on account of possible injury to reforestation or watershed cover. Furthermore, on ranges used in common by a number of small cattle owners, it is seldom practical to let a single individual graze sheep. Numerous requests of this kind when placed before the local livestock associations resulted in requests to the supervisor not to allow the change.

LIVESTOCK LOSSES

The losses of permitted livestock during the calendar year 1925 were materially lessened, in consequence primarily of improved range conditions. Table 10 shows the losses in each of the national forest districts. The total for cattle and horses was less by 1,868, or 4.7 per cent, than in the preceding year, and for sheep and goats less by 29,118, or 18 per cent.

TABLE 10.—*Livestock losses on national forests, 1925*

District	From poisonous plants		From predatory animals, disease, and other causes		Total	
	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats
1.....	202	1,252	720	12,539	922	13,791
2.....	1,921	3,755	1,187	10,611	3,108	14,366
3.....	987	1,483	24,138	7,550	25,125	9,033
4.....	2,478	10,892	2,679	50,555	5,157	61,447
5.....	484	2,333	1,053	9,322	1,537	11,655
6.....	258	2,618	999	14,178	1,257	17,396
7.....			144	16	144	16
Total.....	6,330	22,333	30,920	105,371	37,250	127,704

GRAZING ON MUNICIPAL WATERSHEDS

About two and one-half million people, living in over 700 cities or towns in the Western States, obtain their

water supplies from areas within national forests; and in many instances the Forest Service has entered into special agreements with municipalities for the more complete protection of

their domestic supply of water from diminution or contamination. A pronounced public sentiment exists against the grazing of livestock, and especially sheep, on watersheds from which municipal supplies are derived. Sanitary engineers, however, hold that danger of contamination is not from the livestock but from the presence of human beings on the watersheds. The question of contamination by stock was submitted to the Washington State Board of Health by the city of Walla Walla, which draws its water from the mountains above it, within the Umatilla National Forest. The board of health after an investigation advised the city that the removal of all stock would not insure purity, and that filtration was the only practical way to bring this about.

Nevertheless the city appealed to the Forest Service to prohibit all grazing on the area, under the terms of an agreement previously made for the protection of the watershed. The United States Public Health Service, after a full investigation, informed the Forest Service and the city of Walla Walla that the elimination of all stock from the area would not make the water safe, because all human occupation of the land could not be eliminated. "States have not passed laws to prohibit grazing on watersheds," the report states, "because it is generally agreed among sanitarians that diseases are not transmitted by water from animals to man." This decision by the highest authority will be accepted by the Forest Service as settling the general question, although its application will necessarily be governed by local conditions and the terms of outstanding agreements with municipalities.

REMISSION OF GRAZING FEES

On December 8, 1925, Congress authorized the remission of grazing fees "during the calendar year 1926 or any part of such calendar year."

Under this authority the waiver of grazing fees in drouth-stricken regions ordered by the Secretary of Agriculture for the second half of 1925, as set forth in last year's report, was extended to cover the first half of 1926. It affected all forests in Arizona and those farthest south in Utah, and all of the forests in New Mexico except the Santa Fe and Carson. The Manzano in the latter State was added to the list of forests on which the fees were waived, because serious conditions as to forage and water had developed. Thus no grazing fees were

charged on the above forests for the entire fiscal year 1926, except on the Manzano, where the waivers applied for the last half of the fiscal year only. In round numbers the remittance for the fiscal year 1926 totaled \$400,000. The sum remitted for the same forests for the last half of the fiscal year 1925 was about \$200,000. By the end of June, 1926, the forage conditions on the southwestern ranges were much better and the financial outlook for the livestock business was so greatly improved as to make unnecessary remission of the fees after September 30 of the current year.

STABILITY OF RANGE USE

In last year's report mention was made of the need for seeking stable use of the national forest ranges, of the limitations within which sound public policy requires efforts to promote stability to be confined, of the adoption of the 10-year grazing permit as a measure designed to give greater stability of use and through this to aid in stabilizing the national forest livestock industry generally, and of the pressure from stockmen for much more extreme measures. It was pointed out that the extreme measures advocated by the stockmen, if adopted, would vest in the individuals now using the range permanent rights in the land, would bring to an end effective control of grazing by the Forest Service, and would make impossible adequate protection of other forest resources and public interests in the properties.

Complaints on the part of stockmen against the system of grazing administration were investigated in detail during the latter part of the fiscal year 1925, and the first part of the fiscal year 1926 by a subcommittee of the Senate Committee on Public Lands and Surveys. This investigation was made under a Senate resolution reading in part:

"The Committee on Public Lands and Surveys, or any duly authorized subcommittee thereof, is authorized to investigate all matters relating to the national forests and the public domain and their administration, including grazing lands in the forest reserves and other reservations of lands withdrawn from entry."

Hearings began April 17, 1925, in Washington and were continued at many western points. They were concluded in Washington in March, 1926. They revealed a fairly united demand for legislation from the stockmen heard, along the following lines:

1. A recognition, definition, and protection by law of rights to graze upon national forests on an area basis, the rights to be based upon established priority of grazing use at the time of the enactment of the law.

2. Such rights to be permanent and transferable in full, but their holders to be responsible for willfull damage to the forests.

3. All contested points between the holders of rights and the Government to be subject to court adjudication.

4. The establishment of independent State boards of appeal to pass on decisions of forest officers not satisfactory to permittees. Decision by these boards to be final and not subject to review by the Secretary of Agriculture.

5. The issuance of long-term permits, preferably for not less than 10 years, which should not be subject to alteration during their term.

6. The determination of grazing fees primarily upon the cost of administration, or at least a continuation of the current fees without increase. There was a general protest against the "commercialization" of range use through charging fees comparable to those paid for private range lands.

In the main these demands were inconsistent with the act of Congress creating the national forests and subversive of the policies and practices established by over 20 years of administration. It was obvious, however, that many of the stockmen heard by the committee sincerely believed that as citizens of the United States and residents of the State in which a national forest is located they were entitled to the assured use of a certain portion of the forest for grazing. On the other hand, small owners felt that they were being discriminated against in favor of large owners, whose present privileges should, they felt, be cut down more drastically to make room for farmers and small livestock producers, whom they held to be more dependent on Government range. The large owners, however, complained of the present Forest Service requirements under which gradual reductions to let in small owners are brought about.

With a carrying capacity on national forest ranges that will take care of not over one-third of the livestock in the national forest States, all demands can not be met. If present permittees were to be given exclusive rights of use in perpetuity, new users could come in and small owners could get more pasturage only by buying or

renting rights previously established. The Forest Service has always held it contrary to public policy and to justice to permit the creation of vested individual grazing rights in the national forests. It is convinced that the adequate protection of forest growth, watershed cover, wild life, and the productivity of the ranges themselves require the continuation of grazing only as a **privilege of use**, made as stable as other considerations warrant but still subject to curtailment or adjustment from time to time. The same policy is believed necessary in order to permit the most equitable distribution of grazing privileges on the national forests as the future needs of western agricultural and livestock communities may determine.

No report of findings has as yet been made by the Senate investigating committee, but several bills covering the grazing use of the public domain and the national forests were introduced. One of these received the approval of the Departments of Agriculture and the Interior. Its chief features relating to the national forests were:

Definite legal recognition of grazing as a subordinate use of the national forests.

Provision for the continued regulation of grazing along the same general lines as are at present established.

Requirement that reasonable grazing fees shall be fixed with regard to the stable value of the forage, and also with adequate allowance for the restrictions and duties imposed upon the permittee for the protection of resources of the forest.

Provision for giving permits a contract status to secure the holder against arbitrary reductions in the numbers of stock allowed on the range or other changes not specifically provided for in the contracts.

Contracts to be for a term of 10 years unless a shorter term is requested by the applicant or is determined by the Secretary of Agriculture to be in the public interest.

Preference to be accorded present permittees who own or control adequate ranch property or range improvements dependent for their beneficial utilization upon grazing in the forest.

Provision by the Secretary at the time of making contracts for a redistribution of the grazing privilege to admit new qualified applicants and to promote the economic development of the locality.

Authorization of local grazing boards with a majority of their members selected by the permittees, to cooperate in administering the act and to decide appeals from decisions of forest officers, subject to final review of appealed cases by the Secretary of Agriculture.

The Forest Service believes, in a word, that grazing may properly be recognized by law as a desirable and permanent form of use of the national forests, subordinate to and correlated with their major purposes of timber production and watershed protection. Such a legal recognition will bring certain advantages of assurance and stability to the livestock interests which utilize these resources and should continue to utilize them. At the same time, if adequate provision is made for the administrative control and regulation of grazing, such a course will, it is believed, be in harmony with and in no wise contrary to our accepted national policy of conservation.

The first session of the present Congress closed without enactment of any legislation on grazing, but by regulation of the Secretary of Agriculture provision was made for local grazing boards of review made up of stockmen selected by the permittees and one Forest Service official. Decisions of these boards may be reviewed by the Secretary of Agriculture.

Immediately on the issuance of this regulation all permittees were circularized by each forest supervisor urging that the necessary elections be held. In a large number of forests the advisory boards of the livestock associations refused to call the elections, stating that the present procedure for appealing from decisions of local forest officers was satisfactory and no change seemed desirable. To date only one or two such boards have been organized in the 160 national forests. No cases have as yet been before them for action.

Ten-year permits had been in effect for some time previous to the Senate committee hearings. In 1926 over 50 per cent of the permits outstanding are for the 10-year period.

The question of grazing fees has been given a thorough and independent review by Dan D. Casement, whose report is now before the Secretary of Agriculture. The Forest Service is not committed to any particular schedule of fees, but believes that the principle of fair compensation for the value of the forage utilized is an essential part of the entire program of

stabilizing range use, which it is seeking to put into effect.

RECREATION AND GAME

The number of people using the national forests for recreation in 1925 was one-third greater than in the preceding year, and five times as great as in 1917. This form of use represents in the aggregate a very large service obtained by the public from its forest properties, as a sort of by-product. The economical and social importance of this by-product is of far too material consequence to be ignored, even though it comes about mainly through free exercise by the people of their right to enter upon the forests as they choose, for all proper and lawful purposes. That right should not be restricted without urgent reason; it should rather be recognized administratively, and its exercise provided for in such ways as are necessary to enhance its value and facilitate its enjoyment. Hence the need for a national forest recreation policy.

That policy rests upon two cardinal principles—the right of the public under the law to use the forests for this purpose, subject to the rules and regulations prescribed by the Secretary of Agriculture, and the duty of the Forest Service to obtain from the forests the largest possible net total of public benefits, or the “greatest good of the greatest number in the long run.” Previous reports have pointed out the problems involved, the general course that is being pursued, and the urgent need for a moderate outlay to lessen the hazards arising from large recreational use. These hazards are of two kinds—hazards to which the public properties are exposed through lack of adequate fire control, and hazard to the public health through unsanitary conditions.

As has been repeatedly pointed out before, the primary requisite to meet this hazard is improved camp grounds, made fire-proof, supplied with pure water, and provided with sanitary toilets and means for garbage disposal. The cost of such improvements is relatively small. The appropriation for this purpose was \$40,000 as against \$25,000 for the fiscal year 1925. The Forest Service also received many co-operative contributions of funds, materials, and services for the same purpose. All told, 148 additional camp grounds were at least partially equipped during the year, increasing the number to 599.

There remains a shortage of very necessary facilities upon approximately 1,000 heavily used areas. The Federal Government should not allow its immunity from local sanitary regulations to partially nullify State laws and thus relieve it from compliance with the requirements to which private landowners are subject for the protection of the public health. Immediate improvement of enough camping places to accommodate the present public use would cost approximately \$250,000. In comparison with the protection that would be afforded the public properties and the health of large numbers of people who congregate on small areas without proper facilities the outlay involved is trifling.

For some years the Forest Service has cooperated with State health authorities for the determination and enforcement of necessary sanitary precautions. The cooperation of the United States Public Health Service has also been obtained. Study by a member of that organization of the sanitary requirements in the national forests of the southern Appalachian region is under way. The United States Public Health Service feels that specific sanitary problems which are purely intrastate in character should be worked out in cooperation with the State health authorities, but its cooperation will greatly aid the Forest Service in determining the fundamental requirements.

One consequence of the increasingly intensive use of the national forests for recreation is a growing sentiment in favor of the preservation of wilderness areas; that is, areas maintained as nearly in a state of nature and as free from highways, summer-home communities, resorts, and forms of industrial occupancy and use as the minimum requirements of national forest protection and management will permit. The Forest Service is sympathetic with the general conception of preserving within the national forests a number of areas especially adapted to the wilderness form of recreational use and wild-life propagation. The idea has merit and deserves careful study, but its correlation with the other obligations and requirements of national forest administration must be carefully worked out before definite steps are taken to give any areas a wilderness status. It is inapplicable where the limitation of road construction and other forms of development or utilization of forest resources would be unjust to dependent local communities or to the States. No gen-

eral policy can be applied; specific situations must be weighed individually, considering in each case the relative values involved and the general obligation to protect and administer the national forests in ways yielding the largest net results in public welfare.

In working out this policy it must be recognized that certain forms of economic use, such as the moderate grazing of livestock or water storage that does not materially change natural conditions, may not necessarily interfere with maintaining the wilderness aspect of a region as far as it relates to modes of transportation and forms of recreational use. The same applies to the harvesting of mature timber under proper regulations and an assured continuity of forest cover. The "wilderness" idea, as applied to national forests, will be greatly promoted if in its application to individual areas reasonable flexibility is allowed in providing for really urgent needs of the State or local communities.

Annual estimates are made of the amount of game on each forest. That of December 30, 1925, showed a continued upward trend in the numbers of deer and elk. The total for deer was 10 per cent greater than in 1924 and for elk nearly 20 per cent greater. Of the more than 600,000 deer 227,000 are on the national forests of California, while Arizona, Oregon, and Idaho have more than 50,000 each.

The two greatest herds of elk are in the Yellowstone region. From their respective locations they are known as the northern or park herd, and the southern or Jackson Hole herd. Both are in a perilous situation.

The Jackson Hole herd was first counted by forest officers in 1916. It then numbered over 20,000. An unusually hard winter in 1919-1920 left only 9,320. At the close of 1925 the number had risen to over 25,000. The calf crop for the spring of 1926 is estimated at about 6,000 head, so that approximately 30,000 animals will enter the winter of 1926-27.

As has been repeatedly pointed out in previous reports, the limiting factor on both the Yellowstone elk herds is winter feed. Deep snows in the mountains force the animals down the valleys, where ranchers and grazing of domestic livestock on private and open public range lands have severely curtailed their natural food supply. The larger the herds the greater the danger of heavy losses from starvation in hard seasons.

For a number of years, to supplement the forage purchased by the game commission of Wyoming, the Biological Survey has maintained a hay ranch at Jackson to provide hay for the elk in years of need. To enlarge this ranch the Izaak Walton League undertook to buy additional land. My report of last year specified as available for purchase 4,900 acres. Of this the Izaak Walton League has acquired 1,760 acres. There is no present prospect of further purchases.

The situation still leaves the Government without assured means of maintaining the southern elk herd at its present size. In fact, it is doubtful if all the forage resources locally available could carry the present numbers of elk through a severe winter. And the yearly increase in numbers is bound to continue in favorable seasons. The logical procedure is to fix the maximum size the herd should reach, based on the available winter range supplemented in severe winters by the hay available, and then annually dispose of the surplus. Otherwise another winter will come like those of 1910-11 and 1919-20, when the elk starved by thousands. In 1919-20 the Biological Survey expended \$36,000 and the State of Wyoming \$35,000 for hay to save the elk in this herd, but with limited success, as the count in the year following proved.

Such a method or lack of method of game management is deplorable, and an unnecessary waste of a natural resource. The Forest Service is anxious to cooperate with other agencies to end this unfortunate situation. A carefully designed plan, calculated to hold the elk herd at stable numbers through good years and bad by removing all or a portion of the natural increase is needed. An increase in the number of elk allowed each hunter, a somewhat longer hunting season, and possibly a lower fee for nonresident hunters are among the remedial measures called for. These are matters fixed by the Wyoming game laws.

A similar condition exists with the northern or park herd, and to a certain extent with the third largest herd of Rocky Mountain elk, known as the "Sun River" herd, in the Lewis and Clark National Forest of central Montana. For the northern Yellowstone herd the most pressing need is the acquisition by the Government of certain lands lying in a comparatively

narrow strip along the Yellowstone River, just north of the park, as winter elk range. An act approved May 26, 1926, places this strip within the Gallatin and Absaroka National Forests, authorizes the Secretary of the Interior to accept donations of lands within the area, or of funds for their purchase, and also authorizes acquisition of private holdings through exchanges of national forest land or timber elsewhere in Montana. Steps are now being taken to work out a plan of acquisition whereby the lands necessary for the elk will be acquired, partly through private donation and partly through exchanges.

Here again the most fundamental matter is to determine how large an elk herd can be sustained with the forage resources available. Even though the winter range is extended and reserved for the use of the elk, the herd should be held at a number safely within the capacity of the range. Systematic utilization of the surplus above the established limit should be provided for instead of letting the elk multiply, only to die in large numbers through starvation.

The Sun River herd in central Montana has increased to the limit of the available range. In 1910 this herd numbered less than 300. In 1925 it contained over 3,500 and the increase during the spring of 1926 was very large. Fortunately in 1924 the Montana Legislature lengthened the open season on elk from 10 to 30 days, which considerably increased the numbers removed by hunters in the fall of 1925. Nevertheless, there is still an annual net increase of about 10 per cent. The range is now carrying every elk it can without overgrazing, and enlargement of the game preserve is impracticable.

The future management of these three large elk herds on sound lines is being sought through correlated State and Federal effort, based on an accepted common policy. The first essential is determination of the size at which each herd shall be maintained. This involves a decision as to how far domestic livestock production should be restricted to allow place and forage for elk. The next step necessary is to bring into balance the natural increase of the herds and the factors making for their diminution, in some less violent, catastrophic, unintelligent, and unhumane way than periodic widespread starvation. In

the main this means careful adjustment of hunting to keep the utilization equal to the natural but somewhat fluctuating increment, so that the herds may neither be unduly cut down nor enlarged beyond the carrying capacity of the land.

The Federal Government owns most of the land on which the elk feed, and the States through their game laws regulate the utilization of the product. The Forest Service has sought and will continue to seek, a solution of such game problems, as they arise, on the basis of cooperation with the State game departments.

In Arizona a somewhat similar situation has been created by the increase of deer on the Kaibab National Forest, which was made a Federal game preserve by act of Congress in 1906. Authority was conferred at that time upon the Department of Agriculture to regulate the taking or killing of game animals. Legal steps have appeared necessary to determine the scope of the Secretary's jurisdiction under the law, through an application for an injunction to prevent interference by the State with the killing and removal of deer under Federal permit.

Previous reports have set forth the salient facts regarding the seriousness of the situation. Efforts to obtain the consent of the State game authorities to an increased bag limit and reduced cost of hunting license to nonresidents so as to encourage more hunters to visit the region have been unsuccessful. The summer of 1926 has resulted in a fine fawn crop and the deer will go into the winter of 1926-27 with a large increase in numbers to take their chances of survival on a range already overcrowded with deer and depleted of forage. In Pennsylvania a somewhat similar situation was met promptly by State game authorities through the creation of a special open season in addition to the regular deer season, allowing the killing of both sexes, free license to landowners, and a special fee of but \$2 to all others. It was estimated that this would result in the removal of about 3,500 animals, which would reduce the deer to reasonable numbers. Similar action by the Arizona authorities would

avert a probable heavy loss by starvation in the near future.

The mule deer of the Kaibab, numbering probably 30,000 animals, comprise one of the most distinctive and valuable herds of wild life in the United States. It should always be preserved as an outstanding feature and resource of this region. But its preservation from the inroads of sudden starvation can not be assured unless a rational plan for holding the herd down to what its ranges will support is speedily put into effect.

Hitherto no estimates of the number of beaver on the national forests have been published. The reports for 1925 show over 114,000, exclusive of Alaska. Probably half as many more are outside the national forests. Under present methods of protection the beaver are increasing markedly.

The value of the beaver is not only as a fur producer. Their effect upon irrigation can not be overlooked. During recent serious droughts in Colorado farmers, by opening beaver dams in the mountains, poured millions of gallons of water down the stream beds and out through the irrigating ditches upon their thirsty lands. On one stream in Colorado crops valued at over \$15,000 were thus saved. The States are obtaining a very satisfactory revenue from the pelts taken by licensed trappers, who capture the surplus animals when the fur is in prime condition. Under proper regulation excellent returns can be obtained permanently without decreasing the supply.

Table 11 shows in detail the estimated number of big-game animals on the national forests in each State at the close of the calendar year 1925, exclusive of buffalo, of which there were 181 on the Wichita National Forest in Oklahoma and 2 on the Pisgah National Forest in North Carolina. The number of black or brown bear, deer, elk, and moose all show increases in comparison with last year's figures. A large apparent increase in the number of antelope resulted from a count on a different basis from that of previous years, when antelope not occupying the forests for the major part of the year were left out of the tally.

TABLE 11.—*Big-game animals and beaver on national forests—estimates as of December 31, 1925—summary by States*

State	Antelope	Bear		Caribou	Deer	Elk	Moose	Mountain goats	Mountain sheep	Beaver
		Black or brown	Grizzly							
Alaska.....		¹ 5,600	¹ 4,900		¹ 50,300		¹ 545	¹ 9,000	¹ 400	(²)
Alabama.....					67					
Arizona.....	1,809	1,233	29		49,638	797			120	185
Arkansas.....					670					
California.....	394	10,833			227,145	156			968	271
Colorado.....	70	2,783	25		23,390	7,358			4,318	47,314
Florida.....					110					
Idaho.....	1,495	5,238	99	68	52,639	5,900	673	3,136	1,135	12,208
Michigan.....		15			95					
Minnesota.....		710		3	3,785		1,010			2,708
Montana.....	470	5,120	436	20	48,024	9,816	1,140	3,700	1,748	15,383
Nebraska.....					50					
New Hampshire.....					7,000					180
New Mexico.....	711	660	22		20,009	76			150	
Nevada.....	165	44			4,355				115	662
North Carolina.....		55			2,750	25				
Oklahoma.....	16				100	250				
Oregon.....	31	5,593	2		58,869	3,689			43	5,849
Pennsylvania.....		120			1,455	10				
South Dakota.....	2				2,280	717				2,176
Tennessee.....		6			36					
Utah.....	15	393			18,421	1,564			270	9,687
Virginia.....		300			35	60				
Washington.....		5,923	20	52	24,740	8,430		2,051	39	11,138
West Virginia.....		60			30					
Wyoming.....	2,390	1,600	60		9,971	33,317	2,693		2,746	6,563
Total.....	7,568	46,286	5,593	143	605,964	72,165	6,061	17,887	12,052	114,324

¹ 1924 figures for Alaska.² No report.

WATER POWER

The status of water-power permits on June 30, 1926, as granted by the Department of Agriculture under the provisions of the acts of February 15, 1901, February 1, 1905, and March 4, 1911, remained substantially unchanged. The number of transmission-line permits in force at the close of the year was 1 greater than a year previously, the number of power-project permits 6 less, and the number of completed power projects 5 greater.

Under the standing cooperative arrangement with the Federal Power Commission for administering the Federal water power act, the Forest Service was asked to make engineering reports in 56 cases and to super-

vise and inspect the operation of 37 permittees or licensees. Of 102 applications for permits or licenses received by the commission during the year, 35 involved use of national forest land. In all the commission has received 726 such applications, of which 273 involved the national forests.

ROADS AND TRAILS

Table 12 gives the accomplishments in and expenditures for road and trail construction and maintenance. The apportionment of road funds among the States for the fiscal year 1927, the total appropriations and authorizations, and the condition of these road appropriations on June 30, 1926, are shown in Tables 13 and 14.

TABLE 12.—*Construction, improvement, and maintenance of roads and trails from forest road appropriations and other Federal and cooperative funds, by States, June 30, 1926*

State	Fiscal year 1926				Total constructed to June 30, 1926		Expenditures to June 30, 1926		
	Constructed		Maintained		Roads	Trails	Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails					
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>			
Alabama	6.5		6.0		6.5		\$30,348.77	\$1,982.65	\$32,331.42
Alaska	19.4	33.5	166.8	243.3	163.4	243.3	2,560,069.33	197,775.37	2,757,844.70
Arizona	228.9	143.2	730.2	781.0	746.6	1,435.2	3,158,943.06	783,714.95	3,942,658.01
Arkansas	55.0	39.0	102.9	258.2	279.8	449.1	666,010.09	24,647.73	690,657.82
California	234.2	209.2	1,889.7	4,514.8	1,182.1	2,168.1	7,846,839.88	2,756,090.97	10,602,930.85
Colorado	169.6	580.3	648.2	4,648.0	973.5	2,590.3	3,951,981.08	703,179.30	4,655,160.38
Florida	18.4		78.6	36.5	110.1		204,405.65	110,400.71	314,806.36
Georgia	6.0		19.0	168.6	19.5	168.6	199,844.17	39,000.00	238,844.17
Idaho	137.2	757.2	1,303.1	7,620.5	1,528.0	5,032.9	7,718,303.97	1,314,381.47	9,032,685.44
Kansas					3.4		2,111.51		2,111.51
Maine		5.5	5.0	40.8	5.0	40.8	24,350.99		24,350.99
Michigan	2.0		90.0		42.4		12,409.83	393.45	12,803.28
Minnesota	48.9	11.0	120.5	300.0	230.4	84.7	348,156.43	198,967.98	547,124.41
Montana	147.7	526.7	892.5	6,422.0	785.1	2,219.3	4,990,107.08	527,457.82	5,517,564.90
Nebraska	6.4		27.5		41.3		48,901.08		48,901.08
Nevada	19.2	57.0	307.8	400.9	385.7	751.5	909,708.08	120,212.41	1,029,920.49
New Hampshire	3.3	11.8	40.1	284.6	32.5	296.4	145,338.34	5,765.17	151,103.51
New Mexico	93.9	63.5	401.2	997.5	516.4	1,245.8	2,528,481.52	235,304.44	2,763,785.96
North Carolina	65.2	23.0	106.1	542.3	124.7	565.3	438,829.94	47,620.63	486,450.57
North Dakota					1.0		57.75		57.75
Oklahoma	.5	.1	33.3		24.5	16.5	42,256.67	8,475.11	50,731.78
Oregon	258.5	701.8	2,482.2	5,745.5	1,863.3	2,412.8	7,463,209.56	4,667,587.40	12,130,796.96
Pennsylvania	8.0		27.0	50.0	34.0		23,698.97	1,005.00	24,703.97
Porto Rico		6.0		30.3		36.3	11,003.74		11,003.74
South Carolina			19.3		16.3	4.0	64,027.66	14,074.45	78,102.11
South Dakota	28.3	13.4	170.6	16.7	219.1	48.0	506,393.34	176,891.01	683,284.35
Tennessee	35.9	19.5	14.8	413.1	78.3	436.1	198,400.28	103,171.17	301,571.45
Utah	83.2	338.8	785.5	1,474.5	890.7	2,407.8	2,284,608.17	683,637.84	2,968,246.01
Virginia	41.3	56.4	96.0	500.3	101.3	696.8	340,279.27	15,232.88	355,512.15
Washington	139.8	526.0	1,443.3	5,364.0	675.5	1,727.6	4,825,490.94	1,360,194.06	6,185,685.00
West Virginia	14.5	160.8	17.7	223.5	33.2	340.6	61,581.01	1,578.29	63,159.30
Wyoming	58.7	410.0	639.1	3,837.0	788.6	1,359.9	2,695,365.37	326,219.55	3,021,584.92
Total	1,930.5	4,693.7	11,965.0	44,918.9	11,882.2	26,777.7	54,301,513.53	14,418,961.81	68,720,475.34

TABLE 13.—*Distribution among the States of the total appropriation and of the apportionment for the fiscal year 1927*

State	10-per cent fund		Section 8 fund, total	Federal forest road construction fund, total
	Fiscal year 1927	Total		
Alabama	\$38.14	\$526.50	\$15,456.04	\$1,922.31
Alaska	11,334.76	116,403.19	466,132.50	192,435.28
Arizona	11,670.59	477,591.58	601,167.28	455,986.96
Arkansas	9,444.32	78,051.33	174,939.40	129,640.85
California	128,056.16	958,840.23	1,450,510.39	1,198,962.84
Colorado	41,178.92	511,162.03	755,854.39	777,835.24
Florida	2,951.90	25,532.19	119,528.14	22,001.25
Georgia	1,016.67	6,209.98	50,964.29	134,390.54
Idaho	78,126.33	660,046.58	1,190,614.66	1,357,953.20
Kansas		1,867.27		
Kentucky	166.10	166.10		
Maine	240.83	1,788.18	32.41	3,738.77
Michigan	78.45	944.20	7.00	3,000.00
Minnesota	4,923.97	24,155.45	7,707.98	108,190.85
Montana	23,238.44	472,526.25	741,920.25	731,197.23
Nebraska	817.18	14,502.38	18.98	
Nevada	9,530.84	129,914.80	194,190.47	82,320.99
New Hampshire	3,053.78	22,798.38	341.66	10,857.64
New Jersey	15.32	15.32		
New Mexico	7,183.79	285,475.08	427,989.45	509,744.74
North Carolina	1,743.50	24,283.51	84,556.16	176,501.15
North Dakota		45.75	7.00	
Oklahoma	834.32	7,242.75	65.49	2,775.17
Oregon	77,715.11	658,910.30	1,416,487.23	1,076,735.13
Pennsylvania	187.38	293.38	24.04	21.42
Porto Rico		3.70	7.00	3,343.09

TABLE 13.—*Distribution among the States of the total appropriation and of the apportionment for the fiscal year 1927—Continued*

State	10-per cent fund		Section 8 fund, total	Federal forest road construction fund, total
	Fiscal year 1927	Total		
South Carolina.....	\$238.33	\$904.62	\$402.10	\$48,150.05
South Dakota.....	11,642.31	112,410.19	83,167.35	79,674.98
Tennessee.....	1,564.91	12,971.40	78,254.74	28,154.47
Utah.....	15,347.01	302,004.88	443,998.19	465,492.11
Virginia.....	3,812.94	25,472.00	61,009.95	71,355.58
Washington.....	40,443.84	362,227.42	936,313.70	714,038.70
West Virginia.....	501.52	2,905.80	9,921.47	5,049.24
Wyoming.....	27,111.72	304,347.20	460,882.72	548,628.45
Undistributed.....			227,527.57	59,901.77
Grand total.....	514,209.38	5,602,539.92	10,000,000.00	9,000,000.00

State	Forest highway fund		Forest development fund		Grand total
	Fiscal year 1927, appropriated and authorized	Total	Fiscal year 1927, appropriated and authorized	Total	
Alabama.....	\$3,886.00	\$16,169.00	\$6,406.00	\$25,297.00	\$59,370.85
Alaska.....	473,844.00	2,629,512.00	19,009.00	135,776.00	3,540,258.97
Arizona.....	278,446.00	1,589,585.00	90,615.00	777,522.00	3,901,852.82
Arkansas.....	33,836.00	188,881.00	47,975.00	247,102.00	818,614.58
California.....	681,222.00	3,891,888.00	408,164.00	2,216,566.00	9,716,767.46
Colorado.....	335,972.00	1,916,939.00	166,534.00	1,000,664.00	4,962,454.66
Florida.....	12,098.00	63,859.00	21,861.00	57,684.00	288,604.58
Georgia.....	11,063.00	45,155.00	20,112.00	77,946.00	314,665.81
Idaho.....	510,637.00	2,914,252.00	631,776.00	3,519,636.00	9,642,502.44
Illinois.....	391.00	391.00	190.00	190.00	581.00
Kansas.....					1,867.27
Kentucky.....	1,610.00	1,610.00	3,232.00	3,232.00	5,008.10
Maine.....	1,262.00	7,263.00	578.00	10,650.00	23,472.36
Maryland.....	352.00	352.00			352.00
Michigan.....	2,392.00	12,039.00	11,158.00	42,729.00	58,719.20
Minnesota.....	29,376.00	168,277.00	65,573.00	237,776.00	546,107.28
Montana.....	403,872.00	2,321,035.00	289,443.00	1,973,685.00	6,240,363.73
Nebraska.....	4,675.00	28,870.00	1,312.00	24,474.00	67,865.36
Nevada.....	96,939.00	553,886.00	5,229.00	94,374.00	1,054,686.26
New Hampshire.....	16,115.00	92,455.00	13,557.00	78,858.00	205,310.68
New Jersey.....	837.00	837.00	380.00	380.00	1,232.32
New Mexico.....	211,035.00	1,211,959.00	135,030.00	617,376.00	3,052,544.27
New York.....	706.00	706.00	456.00	456.00	1,162.00
North Carolina.....	13,785.00	75,954.00	29,366.00	155,319.00	516,613.82
North Dakota.....					52.75
Oklahoma.....	2,113.00	14,185.00	346.00	21,596.00	45,864.41
Oregon.....	580,591.00	3,225,933.00	516,486.00	2,574,614.00	8,952,679.66
Pennsylvania.....	3,437.00	10,269.00	8,532.00	37,017.00	47,624.84
Porto Rico.....	599.00	3,759.00	290.00	11,255.00	18,367.79
South Carolina.....	1,895.00	6,255.00	4,990.00	28,740.00	84,451.77
South Dakota.....	35,343.00	203,254.00	19,276.00	132,183.00	610,689.52
Tennessee.....	9,951.00	54,970.00	18,519.00	86,100.00	260,450.61
Utah.....	172,530.00	987,504.00	67,079.00	412,065.00	2,611,064.18
Virginia.....	16,093.00	79,055.00	25,144.00	150,457.00	387,349.53
Washington.....	326,755.00	1,883,310.00	250,415.00	1,973,410.00	5,869,299.82
West Virginia.....	4,923.00	23,214.00	17,954.00	61,586.00	102,676.51
Wyoming.....	221,419.00	1,276,418.00	103,013.00	713,285.00	3,303,561.37
Undistributed.....					287,429.34
Grand total.....	4,500,000.00	25,500,000.00	3,000,000.00	17,500,000.00	67,602,539.92

TABLE 14.—*Condition of road appropriations on June 30, 1926*

Fund	Total appropriations to June 30, 1926	Total expenditures	Unexpended balance
10 per cent.....	\$5,088,330.54	\$4,759,272.01	\$328,958.53
Section 8.....	10,000,000.00	8,819,680.40	1,180,319.60
Federal forest road construction.....	9,000,000.00	8,876,468.00	123,532.00
Forest highways.....	21,000,000.00	17,899,133.14	3,100,866.86
Forest road development.....	14,500,000.00	12,678,751.91	1,821,248.09
Total.....	59,588,330.54	53,033,405.46	6,554,925.08

The amount of forest highway and forest development funds as actually appropriated for each fiscal year is shown below:

Fiscal year	Forest highway fund	Forest development fund
1922.....	\$2,500,000	\$2,500,000
1923.....	7,000,000	3,000,000
1924.....	3,500,000	3,000,000
1925.....	3,500,000	3,000,000
1926.....	4,500,000	3,000,000

The development of forest highways in Alaska requires a somewhat different policy from that in the States. In the latter immediate economic requirements or demands for public travel are the main consideration. In Alaska, it is incumbent upon the Government to recognize the needs of a frontier region, all but a negligible portion of whose land is in Federal ownership. Alaska contains enormous undeveloped economic resources, and a constructive policy toward the Territory and its future requires a liberal construction of transportation facilities to promote the comfort and permanency of the present population, to extend settlement, and to encourage the exploration and development of minerals, timber, and fisheries.

It is necessary to look ahead, anticipate the probable development of the natural resources, and provide for the needs of a new country and a growing population. Means of access must be provided for the extension of the pulp and paper industry, the development of prospective mining districts, and new fishing plants and settlements. Roads are prerequisites for such projects and should be built in advance. The forest highway system as now established and the construction programs approved recognize this condition. The Federal highway act of 1921 and the current authorizations thereunder doubtless make available more funds than are needed immediately to construct the roads required under present conditions in the national forests of Alaska. The construction programs approved from year to year, however, are not designed to expend all the funds available but only to take up such projects as are justified under the general policy indicated above.

MAPS AND SURVEYS

During the year 30 $\frac{1}{4}$ -inch maps and 23 $\frac{1}{2}$ -inch maps covering 38 na-

tional forests, were printed. These maps were compiled and drafted by the Forest Service from data obtained from other Federal organizations, from local agencies, and from Forest Service surveys. In addition, 4,000 atlas sheets, covering eight folio pages of one forest, drawn on a scale of 1 inch to the mile, were issued.

Approximately 1,500 square miles of virgin forest land in Idaho and Washington were mapped on a drainage basis. The control for these surveys was executed to the standard prescribed by the Federal Board of Surveys and Maps.

In the State of Montana a cooperative survey project was initiated with the General Land Office whereby a standard topographic survey of each township is made at the time of the regular subdivisional surveys. This has proved very successful and has produced a map of high standard at a very low cost.

Numerous small projects involving timber, grazing, and land-exchange areas were topographically surveyed.

After the passage of the Temple Act, in February, 1925, it was hoped that considerable progress would be made in mapping the national forests. The bill authorized but did not appropriate funds. Subsequent appropriations by Congress have been insufficient to permit of any new mapping of Federal projects other than those on which State cooperation is obtainable. This has excluded all new national forest projects. It is estimated that 46 per cent of the area of the national forests has been topographically surveyed to a standard which is at present satisfactory. The remaining 54 per cent, or approximately 99,000,000 acres, is in need of accurate topographic surveys. Topographic maps of the forests constitute an essential administrative tool in connection with plan-wise development and satisfactory utilization of resources, and efficient protection, and some way for making more rapid progress in obtaining these maps is an urgent need.

RESEARCH

FOREST EXPERIMENT STATIONS

To grow an adequate supply of forest products is going to be far more difficult than is generally realized. By far the greater part of the original timber area has been burned or cut over; much of it is unproductive; and a still greater part is only partially productive. Forest land, approximately one-fourth of the total land area of the country, is subject to

many kinds of climate, presents innumerable variations in soils, and has the widest physiographic and topographic differences. These complex physical conditions are matched by the variety and complexity of the natural forest growth.

The forests of the United States contain over 100 tree species of present commercial importance, and over 200 less important species, to say nothing of other forms of vegetation. Each has its own requirements and characteristics. The forest crop must be produced, if it is to be anything better than a wild land yield, through careful control of natural plant associations and competitions.

There are also the effects of insect pests, tree diseases, and livestock, and many relationships between the forest and native animal life. To raise sufficient timber in time to meet the national needs calls for accurate and thorough knowledge along many lines.

At first by the costly, time-consuming, trial-and-error method, and later by systematic research, scientific agriculture has been developed. Experience has shown that experiment stations have been the cheapest and most effective means of determining crop-production methods. A similar task lies ahead for forest experiment stations. In 1921 the Department of Agriculture announced its plan to establish experiment stations in each of the important timber-growing regions, dividing the country into geographic units where the forest conditions and forest problems were similar or related.

An excellent start has been made. Four stations have been established in the East and two in the West, with two more or less local field stations—one in the central Rocky Mountain region and one in the Southwest—where forest investigations are proceeding on an exceedingly meager basis. The larger stations are concerned respectively with the forest problems of the northern Rocky Mountain regions, the Pacific Northwest, the Northeast, the Lake States, the Appalachian region, and the South. During the year Congress provided funds for a seventh station, to be located in California. Its organization will permit beginning work upon the exceptionally diverse problems of California and western Nevada—one of the principal sources of the present lumber cut, and a region where forest lands can be made highly productive.

The recognized need for more forest research in the East led Congress to

authorize an appropriation for two additional stations, one for the Middle Atlantic States and one for the Ohio-Mississippi Valley region. The first station will, when established, serve the States of Maryland, Delaware, Pennsylvania, and New Jersey. This section should be nearly self-sustaining in timber. It now imports 90 per cent of the sawed lumber it consumes and pays for freight annually some \$35,000,000. The Ohio-Mississippi Valley station will serve Ohio, Indiana, Illinois, Iowa, Missouri, and the western portion of Kentucky and Tennessee. In these States are some 40,000,000 acres of forest land. Upon the rough, broken, or overflow lands unsuited to farming timber growing can be made an integral part of diversified agriculture. Determination of the forestry practices applicable to the farm wood lot is of major importance in this region. The high-grade native hardwoods constitute a resource of special value.

At least one additional station is needed in the American tropical possessions of the West Indies and the Canal Zone to round out the general program. Practically nothing is known of timber production methods in the American Tropics. The forest growth rate is exceedingly rapid. These forests can very probably produce on American soil such necessary products as camphor, rubber, tannin, and cork, as well as woods not grown in the continental United States.

To meet within a reasonable time the urgent problems awaiting solution by the forest experiment stations is beyond their present personnel and equipment. The Northeastern Forest Experiment Station has taken up only a few of the many important problems of the spruce forests of New England and New York, and has had to leave out for the present the problems of the mixed hardwood and white pine types. The Southern Forest Experiment Station has concentrated mainly upon long-leaf and slash pines, passing by many urgent problems of the short-leaf and loblolly pines, covering only certain phases of the management of some 40,000,000 acres of southern hardwood lands, and doing nothing whatever upon the swamp cypress type of forest. During the year Congress granted an increase for the work in the Appalachian region, thus permitting investigations to be extended at a more rapid rate.

Determining how best to raise and protect the forest crop requires the cooperative assistance of workers in

allied fields. The Bureaus of Entomology and Plant Industry have assigned a limited number of men to the study of forest insect and disease problems at the forest experiment stations. Similarly, the Biological Survey and the Bureau of Soils are aiding through special studies and assignments. There is need of an enlarged attack upon such related phases of the timber-growing problem.

The forest experiment stations receive many inquiries as to the essential measures whereby timber lands can be made and kept productive. To meet this need in part a series of papers is in preparation presenting for each forest region the basic principles of timber growing as far as now known. One bulletin in this series was published on the California pine region. One on the redwood region and one on the Douglas fir region are nearing publication. Most of the rest should be ready within two or three years.

One of the outstanding contributions of the year was the standardization of methods used in the preparation and presentation of volume and yield tables, which are indispensable to the forester in estimating standing timber and predicting growth. In this work, which was largely done at the forest experiment stations, the Forest Service had the cooperation of the Society of American Foresters and the Association of State Foresters. Studies of the growth and yield of the important forest types were continued and several basic and important preliminary phases were finished. They show how much woodlands of different productive capacity will yield at different ages and provide a basis for determining the value of lands for forestry, the product which can be obtained, and the length of the rotation. The studies on which the preliminary work has been completed concern the four important yellow pines of the Southern States, New England spruce, Lake States jack pine, Douglas fir in the Pacific Northwest, and yellow poplar in the Appalachian region.

Somewhat similar yield tables concern resin production from the southern pines. For several years the Southern Forest Experiment Station at its Florida branch has been studying the flow of resin from young longleaf and slash pines. It is now possible to tell how much resin trees of a given size will produce when chipped under conservative working. This study has indicated a close relationship between weather and the

resin flow, particularly with reference to the time when the trees are chipped. Investigations on the influence of weather may change the whole management of turpentine orchards.

FOREST ECONOMICS

Organization of the forest taxation inquiry, called for by the Clarke-McNary Act, was effected during the year by Prof. Fred R. Fairchild, previously appointed to direct the inquiry. The preliminary planning and selection of personnel have in large measure been completed, auxiliary material has been gathered, and methods of field study have been developed. The Lake States were chosen as the region first to be studied and field investigations were begun in Michigan in June. At the close of the year regional headquarters were established at St. Paul, in close proximity to the Lake States Forest Experiment Station. Subsequently a general canvass of sources of material was made, statistical studies covering the entire State were started in St. Paul, and plans were perfected for intensive studies in some half dozen of the more important forest counties, with a still more intensive investigation of certain townships in these counties. Invaluable assistance was received from officers of the State of Minnesota, the University of Minnesota, particularly the College of Agriculture, Forestry, and Home Economics, the Minnesota Tree Society, and numerous individuals.

Uncertainty as to whether timber growing will pay is greatly retarding its adoption by private owners. The practice of forestry would undoubtedly be profitable to a greater or less extent to-day in practically every important forest region in the United States. One of the reasons for economic studies is to learn more of the financial feasibility of private timber growing. Data should be gathered on the many elements making up costs and returns, on the conversion of going concerns with a large remnant of virgin timber now being "mined," to concerns growing their own permanent supplies, on the purchase of second growth lands as a basis for perpetual operations, and on the starting of forests upon denuded lands. There is probably no line of work, unless perhaps the study of forest taxation which should yield facts of greater stimulus to the development of forestry. Such studies will be prosecuted as available resources permit.

A comprehensive study of the economic consequences of extensive denudation of timberlands covered the former forest region of Michigan, where the after effects of lumbering and forest fires, along with the decline and death of forest industries, were compared with conditions in localities where part of the original timber is still standing.

A popular résumé of available data on forest resources of the world was prepared. Collection and compilation of statistics on the distribution and consumption of softwood and hardwood lumber were continued. Work was practically completed on a statistical bulletin comprising nearly 200 tables of data on American forests and forest products.

As in previous recent years, cooperation with the Bureau of the Census was continued in gathering information on the production of lumber, lath, and shingles. Statistics of wood preserved and preservatives consumed were obtained for 1925 and tabulated conformably to the established practice. This series extends back to 1909 and is the only official record of activities in the wood-preservation industry.

In studies dealing with forest economics records of past stumpage and lumber prices are highly important. The records in existence have been fragmentary. Considerable progress was made last year in the compilation of lumber prices for typical products and grades of the more important American timber trees, running back to 1800, although the early records are not continuous. A bulletin on stumpage prices is in preparation containing tables of such prices back to 1860, and a discussion of price trends since 1900.

FOREST PRODUCTS INVESTIGATIONS

The year has brought more definitely to view the integral relationship between research in forest products and silviculture. A notable instance is furnished by the hemlock and hardwood forests of the Lake States. Silvicultural studies had brought out the desirability of logging only the larger trees. Utilization studies had brought out that the smaller trees were being removed at a loss, and that defective trees were better adapted for ready-cut dimension stock than for boards. The Lake States Forest Experiment Station and the Forest Products Laboratory joined to dovetail these three conclusions in a definite system of woods and mill practice which

would combine the best silviculture with the best utilization. The findings have satisfied all expectations and are now being prepared for publication. If put into practice by landowners they will constitute the beginnings of industrial forestry in the hemlock and hardwood type.

Some years ago a study on how to select southern pine for structural timbers showed that the strength of pine wood is determined largely by the conditions under which the tree grows. An experiment is now under way to find out what conditions produce the strongest pine. When this is determined, it will be possible to tell the landowner whether his land is particularly adapted for growing timbers and what silvicultural system will produce them. Similarly, a study of how to select ash suitable for airplane construction showed that the strongest wood is found only in trees which have grown at a uniform rate. Rate of growth can be regulated by thinnings. Thus a study initiated to find out how to select lumber ended in finding out not only how to select but also how to grow it. The same results were found to apply to hickory for handle stock.

The interrelationship of forest products investigation and silviculture is not limited to forest utilization. The basic knowledge of wood which the Forest Products Laboratory is accumulating should throw light upon the most diverse problems, including the fire problem. A duff hydrometer, developed by the laboratory for measuring the moisture content of forest soils, has already proved a real contribution.

The year has also brought more definitely into view the integral relationship that exists between research in forest products and industrial reductions of waste. The idea that the forest-using industries can reduce wastes by voluntarily organizing to apply the results of research found definite expression in the National Wood Utilization Conference called by the Secretary of Agriculture in 1924. This conference resulted in a permanent industrial committee on wood utilization which is now functioning under the auspices of the Department of Commerce. Definite applications of the idea of waste prevention through industrial organization are constantly developing.

The Forest Products Laboratory has acted as technical advisor in the formulation of American lumber standards by the industries which use

wood. Standards for softwood yard and factory lumber, hardwood lumber, railroad ties, and structural timber are in process of formulation by these industries. In the many sharp conflicts of interest that necessarily attend such a process, there is constant need of technical advice, and for emphasis upon the fact that any standard, in order to be permanently acceptable, must be technically sound and must make for conservation. The increasing employment by industrial associations of men trained in products research and the increased demand for the short demonstration courses offered by the laboratory in kiln-drying, gluing, and containers are further proofs of the fact that the investigative work of the laboratory is of basic importance to the success of industrial efforts to curtail waste.

The relation of wood substitutes to forestry is a subject which has only recently gained attention. There has been a popular assumption that substitution by extending the life of the present timber supply would be beneficial to the public. This is true only if the substitute is of superior merit. If, however, wood is displaced not by superior merit but by superior pushing of the substitute, this merely creates uncertainty as to future wood requirements and harmfully discourages the growing of timber crops. The obvious function of forest products research is to provide facts about the properties and uses of wood on the basis of which the public can make its choice of materials intelligently. The substitution issue will probably give rise to a large number of new questions which will tax the capacity of the present products research organization.

Experience makes it increasingly clear that while decentralization of extension and consulting work should be encouraged, fundamental research in forest products, and technological research of Nation-wide application, gain greatly in effectiveness when centralized. For example, basic improvements in kiln drying, air seasoning, and wood preservation, and artificial modification of wood properties are now known to depend upon finding an answer to the single problem of how liquids exist in wood and how they move through it. In addition to the mechanical and chemical engineers heretofore engaged in these lines of work, it has been necessary to enlist the services of a colloid chemist, a mathematical physicist, and wood technologists. The help of a plant physiologist is needed next. By bringing

specialists from these diverse fields together and organizing a concerted attack upon the problem of liquids in wood, much progress is being made which would otherwise have been impossible.

The closing during the year of the Seattle timber-testing laboratory now centralizes all Forest Service work on timber tests at Madison. On the other hand, the laboratory short demonstration courses were extended into the field. There is need of a widespread decentralization of extension work, and of research on local utilization problems among forestry schools, State foresters, industrial associations, commercial laboratories, and consulting foresters and engineers. The past year has disclosed repeated instances in which industrial associations have established facilities to extend and apply research in forest products. There is also a growing need for qualified foresters and engineers to equip themselves for consulting work. The laboratory should to an increasing degree function as a clearing house and source of basic information on forest products, and to a decreasing degree as a consulting agency on local problems.

Notwithstanding the growing importance of forest products research the man-power available to the Forest Service has decreased. The Forest Products Laboratory now has 181 employees. During the war the number reached 450. The laboratory can not continue indefinitely to serve the increasing demands without an expansion of personnel.

Concrete examples of results obtained during the past year include the following: The effects of possible standard thicknesses for the so-called inch board upon its value for various uses, and upon the amount and nature of manufacturing wastes, were investigated more thoroughly than had heretofore been attempted. This investigation is still under way. Meanwhile the lumber standards conference adopted twenty-five thirty-seconds of an inch and twenty-six thirty-seconds of an inch as the thickness of the "standard" and "industrial" boards respectively. Grading rules for hard wood lumber were studied exhaustively and a new basis for grading rules was arrived at which reduced wastes materially without impairing the quality of grades. The rules committee of the National Hardwood Lumber Association has recommended for trial a system of revised grades intermediate between the present grades and the new ones proposed by the laboratory. Th

laboratory's recommendations for improved grades for structural timbers were adopted by the American Railway Engineering Association and the American Society for Testing Materials, and were recommended by the lumber standards conference for incorporation in the rules of the regional lumber associations.

The results of the laboratory's study of industrial outlets for softwood yard lumber were published. A mill study in the Inland Empire, conducted by the Idaho-Montana district, yielded valuable figures on degrade during river driving and figures on overrun and grade yields which afford a greatly improved basis for forest management plans and timber sales in that region. The mill and woods study conducted in the Lake States has already been described. A similar study will be made in the short-leaf pine stands of Arkansas this winter.

Further progress was made in working out on a laboratory scale the possibilities of the semichemical process for pulping hardwoods. The new plant of the Southern Extract Co. at Knoxville, Tenn., is now employing the new process to make board out of extracted chestnut chips. An adaptation of the semichemical principle was worked out for pine chips on a laboratory scale and now awaits commercial trial. Many mills adopted the laboratory's improved cooking methods for increasing the yields and quality of sulphite pulp, and the laboratory's recommendations for reclaiming fiber from white water.

Methods of simplifying the determination of moisture content of lumber were studied to develop a method sufficiently simple and rapid for daily use in sawmills, lumber yards, and wood-working plants. An easy method of determining moisture content would have far-reaching effects in improving industrial practice. The use of unseasoned wood has undoubtedly been one of the main causes of substitutes. Methods of reducing degrade in kiln-drying southern pine and in handling and drying gum were worked out in cooperation with several southern plants. A mathematical analysis was made correlating the effects of the various factors determining the transference of moisture through wood. This work may make possible radical improvements in seasoning methods and methods of modifying the hygroscopicity of wood.

A study of wood as a colloid was begun. A method was devised by which the total cross-sectional area of microscopic and submicroscopic open-

ings can be measured. These measurements will be of great value in learning how liquids exist in and move through wood.

An important discovery was made showing the general location and nature of the lignin in the cell wall. This was accomplished by a new technique in dissolving the cellulose and the extractives. The same idea can probably be used to determine the location of other constituents of the cell. The method of predicting the toxicity of preservatives from their chemical composition was further developed and verified. The chemical nature of the extractives in redwood was studied in cooperation with the California Redwood Association.

An analysis of the causes of brashness in spruce and Douglas fir was completed in cooperation with the Navy. Increased demands for information on tropical hardwoods could not be satisfactorily met because of the lack of definite information and funds for carrying on the necessary investigative work. Educational work in applying the results of past studies in increasing turpentine yields was successfully continued. A study was begun on the effect of changes in growth conditions on the structure of wood.

Methods which practically eliminate breakage in steam bending of chair parts were developed on a laboratory scale. This breakage has frequently run as high as 25 per cent. The application of these methods to commercial plants is the next step. To obtain data on the effect of soil moisture on the density and hence the strength of long-leaf pine, an irrigated experimental plot is being established on the Florida National Forest.

The study of glues and gluing methods was continued. The paint durability test fences maintained by the laboratory in various climates are yielding valuable indications of better methods of painting the various species and grades of wood.

The work of the laboratory for the coming year will be focused upon the further correlation of utilization with forestry, the analysis of substitutions for wood as related to outlets for forest products and the use of forest lands, and the prosecution of such basic researches as afford the key to improvements in wood use.

RANGE INVESTIGATIONS

On March 1 the office of grazing research was transferred from the

Branch of Grazing to the Branch of Research. This completes the combination of all the research activities of the Forest Service in one unit.

Grazing utilizes the subordinate vegetation in the forest. This subordinate vegetation has an important influence on timber reproduction, growth, protection and use, and on water flows; and the tree growth and water conditions in turn react upon the subordinate vegetation. The retention and improvement of the most fertile portion of the soil, the checking of erosion, watershed protection generally, and the support of wild life all depend on maintaining the proper interrelation of timber and forage. For this, as well as for producing the most complete and valuable forage crops, grazing research is essential.

In the Southwest especially acute problems are presented for solution. Prolonged drouth has decreased the growth of forage and the resultant overstocking has caused excessive depletion of many ranges. Research will seek better management methods in order that the overgrazing may be corrected without unnecessarily drastic adjustments in the industry. This calls for better knowledge of the value and growth habits of the forage plants, the possible ways of using them, the proper degree of utilization, and the systems of range management which will give the most economical results and at the same time assure maintenance of the carrying capacity and proper correlation of range use with other uses. Again, the rains fall at such a rate that it is often impossible for the soil to absorb more than a small part of the water. The lack of adequate vegetation to bind the soil has caused serious erosion in nearly all parts of the Southwest. This situation requires careful study particularly on such areas as the watershed above the Roosevelt Reservoir in Arizona. The specific factors which control erosion in the region must be determined and methods of range management developed which will allow the vegetation to play its full part in watershed protection.

The injury to forest reproduction by grazing in parts of the Southwest has prevented or retarded satisfactory restocking of approximately 550,000 acres. Research can aid materially to disclose how to insure timber reproduction without unnecessary sacrifice of grazing use.

The interest which stockmen are taking in the results of the Forest Service grazing research is indicated

by the success of the field-day demonstrations of the practical results of the range investigations held last year at the Great Basin Experiment Station in Utah and at the Santa Rita Range Reserve in southern Arizona. At the latter field day it was shown that under the experimental cattle management methods followed on the reserve, a profit of over 7 per cent was obtained from an investment of about \$85 per head, which compares with a loss of over 5 per cent on an investment of approximately \$55 per head on the unfenced adjacent range. The methods gave a larger calf crop, much smaller losses, and better quality cattle, with maintained production during the last 10 years, in 7 of which the rainfall was below normal.

A study of the distribution, growth habits, growth requirements, and value for pasturage of the important western browse plants was completed. Similar work is under way on the western range herbaceous vegetation. Intensive studies were continued at the Great Basin Experiment Station in Utah to learn the resistance of vegetation to different intensities and times of cropping. While too close and too frequent grazing seriously affects the vigor of the vegetation regardless of the period of use, the experiments have shown that if the grazing is not too close, if the first grazing is delayed until the plants have made a good growth, and if the intervals are sufficient to permit recovery from the shock of the previous cropping, it can be repeated twice or three times during the growing season without bad effects.

The cell tissue fluids of range plants were studied at the Great Basin Experiment Station in cooperation with the University of Minnesota to develop some definite relationships between these fluids and the growth habits and forage value of the plants. Determination of ways to improve the stand of the different forage species is the ultimate goal sought.

Study of artificial reseeding of mountain ranges continued. Three years' study of cattle range management on the Madison National Forest in Montana has yielded important results on the relation between the period of grazing and the quantity of forage that can be utilized without injury to the grasses.

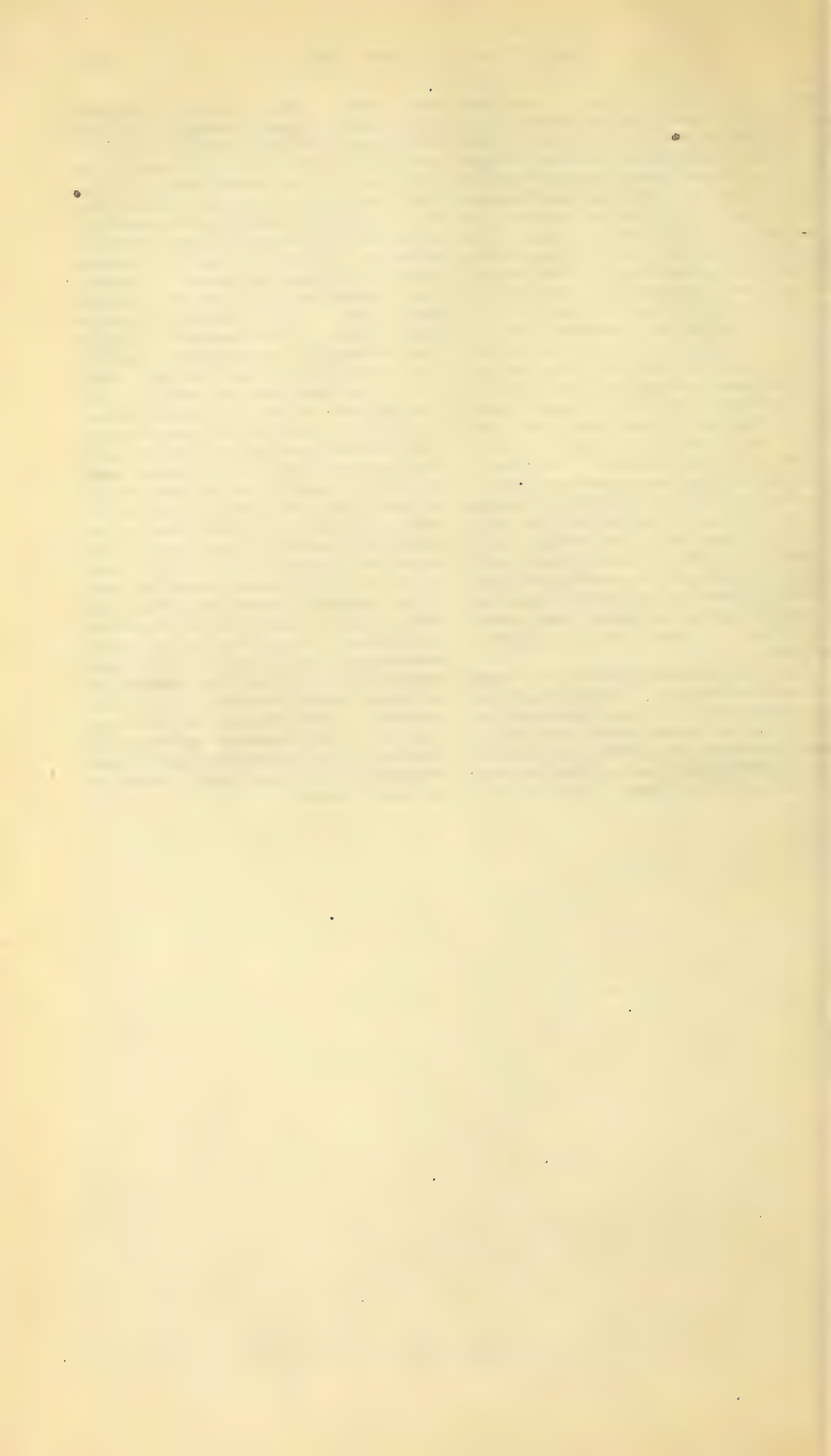
The results of 11 years' study of the relation of herbaceous vegetation to surface run-off and erosion on high mountain watersheds were prepared for publication. Among the conclu-

sions are that properly controlled grazing will not injure watersheds on which the vegetation is in fair condition, but on badly depleted watersheds it may in some cases be necessary to exclude livestock, and that herbaceous vegetation exerts little influence on the amount of run-off and erosion from melting snow, but it does materially reduce the surface run-off and erosion in summer. However, as some 95 per cent of the total annual run-off is due to melting snow herbaceous vegetation has little if any effect on the total run-off.

A manuscript was completed on the utilization of mountain brush lands in southwestern Utah as summer range for cattle, embodying the results of five years' study conducted on the Dixie National Forest. The study determined the forage preferences of the cattle and showed the relationship between gains in weight and the character and amount of the browse. Conclusions regarding management methods were worked out. Additional data were obtained at the Santa Rita and Jornada Range Reserves concerning the effect of range use at different seasons.

With an enormous area of forest range available for livestock grazing, the development of an adequate scientific basis for range use so that it can take its place along with the growing of timber crops as a rightly integrated form of forest land use has

only begun. The same knowledge will serve also for, and is essential for, the development of efficient use of other public and private range lands. In this respect the case closely parallels that which is presented in connection with all forms of forest land use. The urgency of our national situation in forestry demands that the play of economic forces be facilitated and directed in the light of scientific knowledge. Only in barest outline is the economic knowledge now available for thoroughly satisfactory Federal, State, and private forest policies. And the same holds true of knowledge of the methods of timber growing. There is need to provide for the Federal contributions to forest research in a big national way, on a scale commensurate with the magnitude of the problem and the public interests at stake, building upon the regional forest experiment station plan of the department, as approved by Congress, and the work of the Forest Products Laboratory—already under way. Such provision can probably best be made by an organic act covering all the forest research in the Forest Service and perhaps also that in other bureaus of the department, rounding out existing authority, codifying existing law and carrying authorizations sufficient to provide for an ordered and systematic development for some such period as the next decade.



REPORT OF THE FORESTER

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., September 1, 1927.

SIR: I have the honor to transmit herewith the report of the Forest Service for the fiscal year ended June 30, 1927.

Respectfully,

WILLIAM B. GREELEY, *Forester.*

HON. W. M. JARDINE,
Secretary of Agriculture.

FORESTS AND FLOOD CONTROL

The Mississippi flood disaster has called in question the adequacy of our public program of forestry. That such floods can be controlled solely through reforestation is patently impossible. Serious floods occurred in the Mississippi before the natural forest cover of its drainage basin had been disturbed by settlement or lumbering. The flood of 1927 was caused primarily by very heavy rains in the lower valleys. Engineering works alone can restrain the vast quantities of water poured into the channel of the river under such circumstances.

On the other hand, forests aid in the regulation of streams because they hold the soil in place and hold back rain and snow water more effectively than any other form of vegetative cover. This beneficial influence of forests has been widely recognized the world over and widely demonstrated in the experience of the United States. It has been accepted in our national policies for the conservation and extension of forests, specifically in the statute authorizing national forests and defining their purposes and in the Weeks law providing for their extension on the headwaters of navigable rivers. The influence of forests upon stream flow must be gauged with sanity and common sense in consideration of the physical conditions which actually produce great floods. Forests have a place in the plan for dealing with the Mississippi River—but a place that can not be defined in sweep-

ing or general terms. It can be determined only by study of the facts to ascertain where, in the Mississippi Basin, the improvement or extension of forest cover will be of tangible help in supplementing the engineering works upon which the main reliance for the control of destructive floods must be placed.

The control of Mississippi floods is fundamentally an engineering problem, but a broader one than that term might at first suggest. The watershed of the Mississippi extends from the southwest corner of New York to the Panhandle of Idaho and from southern Saskatchewan to the Gulf of Mexico, with a corresponding diversity in all of the factors of topography, soil, climate, and surface cover which influence the regimen of streams. From this vast watershed there will continue to be delivered to the lower river from time to time volumes of water far beyond the capacity of its natural channel to discharge. To store, restrain, or direct these flood waters within set limits through engineering works is the most immediate and acute phase of the problem.

But as we follow the major tributaries of the Mississippi back to their source, the central engineering problem ramifies and new aspects of river regulation appear. The coincidence of high-water discharges, or the lapse of time between them, from the many different tributaries is seen to be a factor of importance. The rapidity with which the winter snowfall is converted into spring freshets, the ex-

tent to which lakes or swamps afford natural flood storage, the capacity of the soil to hold water, the extent to which naked, impervious soils accelerate run-off and erosion, and the presence or absence of surface reservoirs in the form of forests or well-sodded pastures or well-tilled farms are all found to be of significance in the behavior of the innumerable feeder streams and hence in the total volume of water flung into the main channel during the period of flood crests.

Many of these elements which affect surface run-off and erosion are beyond human influence. But the further back study of the facts is carried the more obvious it becomes that what man does with the land has an important bearing on its run-off, that the surface conditions where floods originate are not static but shifting and progressive, and that to attain the most complete control of floods prevention of the rapid movement of water and silt at the source of rivers is necessary no less than structures for controlling the results of such movement in their lower channels.

This study of the land and what we are doing with the land brings forestry into the picture as a means of restraining flood conditions at their source. Forests can not prevent floods, but can reduce them. They retard the melting of snow. They retard surface run-off both directly and through the greater porosity of the underlying soil which they maintain. They retard erosion and reduce the silt burden of streams. Their relative influence in these respects may be greater or less in comparison with the many other factors which affect the regimen of streams. It can not be separated and measured in exact, quantitative terms. Nevertheless it is an influence which should be brought into play in the progressive betterment of conditions which contribute to destructive floods.

SURVEY NOW IN PROGRESS

Following the conference on flood control held in Chicago last June and conferences with the Corps of Engineers of the War Department, the Forest Service undertook to assemble all available data regarding the areas where forests do or can exert a helpful influence on the flow of the Mississippi and where protective forests should be extended. For the purpose of this survey, "protective forests" were defined as "forests which, because of the steepness of the

slopes, erodible soil, or the character of the precipitation, exert directly a beneficial influence upon the behavior of streams." Manifestly where such conditions obtain forest destruction is followed by increased erosion and greater irregularity of stream flow. This survey has been undertaken with a view to presenting its results for consideration when final plans for flood control on the Mississippi are drawn.

For the purposes of the study the Mississippi watershed was divided into five main tributary basins, each subdivided into minor drainages. The amount, character, and seasonal distribution of the precipitation in each drainage basin, the location and character of the different types of physiographic features, such as altitude, slope, ruggedness of topography, and natural reservoirs in the form of lakes, swamps, and overflow lands, and the location, character, and extent of the various classes of vegetative cover now occupying the land will supply a basis for rating (1) the protective value of the various areas on each watershed and (2) the efficiency of the protective cover now present on each area. Compilation will also be made of all available records as to high and low stages of the streams, the average dates of the occurrence of flood stages, and the burden of sediment carried. Upon the assembly of this information, summaries will be prepared showing for each watershed the aggregate forest area of protective significance and its location, and where the protective value of lands now without an adequate forest cover makes reforestation desirable.

While any definite program for employing forestry as a means of flood prevention on the Mississippi must await the completion of the survey now in progress, it appears probable that no additional organic legislation will be required.

A need will undoubtedly appear for the extension of public forest ownership under the Weeks law or the Clarke-McNary law in the mountainous drainages where the natural balance between topography, soil, and cover is easily upset and surface conditions augmenting flood discharges are easily brought about by destructive lumbering, forest fires, or temporary and shifting agriculture. Need will undoubtedly also appear for intensifying the protection of forests from fire on critical drainages of the Mississippi through enlarged cooperation between the States and the Federal Government under the Clarke-McNary Act. Forest

planting should undoubtedly be promoted aggressively on abandoned or eroding farm lands and denuded forest lands where erosion and run-off are now serious. This, too, is authorized by the Clarke-McNary Act through co-operation with the States, although with a present limitation to farm lands which should undoubtedly be removed.

National leadership and the need for national action should be fully recognized; but the fullest measure of co-operation with the States and land-owners immediately concerned should be secured.

To sum up the situation in a word, the behavior of our great rivers and the plans projected for their control can not be separated from the use of land. Behind the great floods in the lower Mississippi lie 800,000,000 acres of land—farms, pastures, ranges, and forests. The conservation and productive use of this large part of the soil of the United States fully justify on its own account all of the foresight and National and State action that can be brought to bear. The loss of farm soils and farm fertility through erosion is a national loss greater in the long run than the property damage created by destructive floods. The creation of productive forests and improved pasture lands will pay dividends on their own account greater than the aid they will render to the regulation of rivers. The main point to be borne in mind is that just as the condition and use of the land have a part in flood prevention, so is the protection of streams one of the inseparable national benefits obtainable through a sound policy of land use.

THE SITUATION IN PRIVATE FORESTRY

There have been no marked changes during the year with respect to the growing of timber on privately owned lands, and there is little prospect of any sudden or striking change. Forest-land practices are undergoing a slow and gradual evolution, and some time must elapse before the results can be appraised in specific terms. The progress in farm forestry is relatively more rapid and pronounced than in industrial forestry. This is indicated by the emphasis now given to forestry in agricultural extension work, by the steady increase in the scale of timber planting on farms, and by the many instances in which timber production is taking more definite form as a farm or farm-community activity.

Industrial forestry on lands of lumber companies, paper companies, railroads, and like owners is gaining ground slowly. Encouraging indications of change in the attitude of such owners toward the possibility of growing timber on their land or of adopting reforestation plans are evident every year. The net gains, however, still fall far short of providing for the future productivity of the 242,000,000 acres of forest land in industrial ownership. The area of cut-over land left in poor productive condition is still enlarging, though probably at a substantially lower rate than 10 years ago. The current growth of timber is probably increasing in response particularly to the expanding protection of cut-over lands from forest fires, but still is far short of replacing the current drain upon the forests. To a degree which has never existed before, industrial forest-land owners are interested in the possibilities of forest management; but a long time will be needed to work out the many problems involved and to make the forests of the country currently self-sustaining.

Among the difficulties which stand in the way are the current depression in lumber markets, the financial obligations imposed by existing investments in plants or timberland, the uncertainty as to the future course of taxation in respect both to merchantable timber and young forest growth, and the burden of raw material wastes still carried by most forest industries of the United States.

Timber waste is standing out more and more clearly both as one of the major handicaps of our forest industries and as one of the most promising lines of attack in promoting industrial forestry. To the extent that a timber crop can be given greater value and utility through closer and more profitable ways of using it, the growing of timber will be encouraged. Some very encouraging developments are taking place in this field. The extension of pulp and paper manufacture in the Northwest is opening a way for profitable use of sawmill and logging wastes which are now a heavy drag upon the lumber industry of the region. The National Committee on Wood Utilization and other agencies are promoting the use of short lumber lengths, small-dimension stock, and other material, all of which tends to lessen waste and enhance the value of forests. In fact, the active search for and development of ways to utilize timber more closely is both a striking proof of the gradual change in the forest industries of the

United States due to the depletion of virgin forests and one of the things most necessary for stable forest industries and paying forestry.

Cooperative public effort is now well organized for overcoming the formidable barriers against forestry created by the hazard of physical loss from forest fires and the hazard of financial loss through burdens beyond the capacity of timber growing to bear. Public and private agencies are working steadily toward more complete and profitable use of timber. A good deal is being done on technical questions of forestry practice, timber yields, and the best methods of harvesting and removing the timber crop. As yet, however, no adequate attack has been begun on many economic questions which must be answered before private land management can be soundly directed toward industrial forestry. This gap should be filled without delay, and public leadership in filling it is greatly needed.

All-round stability of our forest industries is necessary to progress in forestry, and the extension of timber growing on commercial holdings will, by and large, come about only as this stability is attained. The large private holdings of stumpage in the West are proving to be one of the serious causes of instability, affecting not only the forest industries in that region but also many in eastern regions through competition in common markets. The financial difficulty in carrying large timber holdings over long periods of time is forcing many owners to cut as quickly as possible and tends to create an overproduction of lumber. This both causes a rapid and wasteful use of the only large supply of virgin timber remaining in the country and deters private forestry. A difficult problem is presented, which needs to be given consideration in connection with public policies and which merits public assistance for its solution.

In general, the forest industries are giving wider consideration than ever before to applying the principle of sustained yield of timber as a working business policy. Under this principle only as much timber is cut yearly from a given unit of forest land as the land is replacing through growth, so that a manufacturing plant of corresponding capacity can be permanently maintained. Sustained yield is, of course, the underlying idea and essential aim of all forestry. We shall not have solved our national problem until the country as a whole is on a sustained-yield basis, with timber production balancing current use. To the indi-

vidual lumber or paper or other forest industry the sustained-yield conception offers the most rational basis for stabilizing an enterprise throughout. If the forest industries of the West, where large quantities of virgin timber are still available, could forthwith be placed on a sustained-yield basis, the current output of forest products would not be materially curtailed but expansion would be held down, overproduction would be cured at its source, and a rational stability would be introduced into all phases of industrial planning. There is no question that such a development would be in the public interest through conserving and extending the period of use of the remaining virgin timber.

For many of the larger forest industries in the Eastern States, a sustained yield can be attained only after a considerable period of forest restoration and would involve, for a time at least, a reduction from the present rate of cutting. To the business executive, East or West, application of the sustained-yield principle necessarily presents both financial and other difficulties, and it can be expected to gain ground but slowly. It is desirable, however, to recognize that the general reorganization of our forest industries around the sustained-yield conception is necessary, that its accomplishment is the great goal to be sought in connection with the use of forest lands, and that the rate of advance towards that goal will be a conclusive index of our progress as a Nation in forestry.

The whole situation creates urgent reasons for a broadened program of public forest ownership in regions where industrial forestry may thus be most effectively stimulated and supplemented. The southern pine belt and the northern Lake States are outstanding examples. From these two regions much of the softwood timber needed by the Nation in the past has been supplied; and for large sections of the United States they represent the logical and economical future source of such material as well as of other forest products. The timber resources of both regions have been severely depleted. Many large industrial units have exhausted their virgin stumpage and moved out. The southern pine industry and the southern naval-stores industry are finding a new lease of life in the second-growth timber which has come in extensively after logging or on abandoned farm lands. Broadly speaking, in these two regions the forest industries are farthest from the sustained-yield conception. In both,

large areas of cut-over and denuded land have accumulated whose restoration to productive forests is essential from a regional as well as a national standpoint.

Industrial forestry is gaining ground in the southern pineries and the Lake States, but its progress is wholly inadequate to the regional and national needs. At best a serious hiatus in time is bound to occur between the severe depletion of existing timber supplies and the resumption of forest industries on a sustained-yield basis, and this hiatus will be lengthened by whatever period is consumed in bringing back into production these large acreages of cut-over land through the slow and relatively costly process of reforestation.

Of the original forest area in the two regions of more than 330,000,000 acres, from which the Nation has hitherto drawn timber heavily, approximately three-fifths is now classed as forest, but with less than one-eighth virgin forest, while more than 50,000,000 acres, or over one-fourth of the present area of forest land, is unproductive in varying degrees. With every possible extension of industrial forestry that can be anticipated, there is an imperative need for more aggressive public action to aid in restoring the cut-over lands of these two regions to productive forests and in making them fulfill their part in providing a national sustained yield of timber.

In addition to everything that can be done to encourage industrial forestry through research, protection from fire, and the solution of tax and other economic problems, the southern pine region and the northern Lake States particularly call for the extension of public forest ownership. State and national forests would not only restore to timber production the land areas actually embraced in them but also would, as local demonstrations of forestry practice, aid greatly in promoting private forestry around them. In the southern pine region national forests in units of about 100,000 acres each, well distributed and harmonized with the plans of the States for the creation of State forests, would contribute substantially to the working out of the tremendous land problem of that region. In the northern Lake States, a few additional national-forest units of somewhat larger size are needed. In both regions a great increase of State forests is equally important. There is ample room and urgent need for all that the States and

the Federal Government combined can do, through public forest ownership, toward a solution of the regional land problem.

PROGRESS IN STATE FORESTRY LEGISLATION

The increasing interest throughout the country in forestry was evidenced by the legislation of a number of States during the past year. Florida, South Carolina, and Delaware passed laws for the establishment of State forestry departments and the appointment of State foresters. Similar legislation was again proposed in Arkansas, but failed. California created a department of natural resources, under the general supervision of a director, with a division of forestry administered by the State forester and guided as to policies by a State board of forestry. This new department takes over all the powers and duties of the former State forester.

Rhode Island made an important change in its forestry organization by putting it under the department of agriculture, North Carolina revised the board of conservation and development to consist of a membership of 12 instead of 6, and Louisiana provided for an additional member on its forestry board. Virginia created a department of conservation and development, consisting of the conservation and development commission and two other commissions. This change did not, however, materially affect the status of the forestry work of the State, since the conservation and development commission was already in charge of it.

Ohio authorized the board of control of the Ohio Agricultural Experiment Station to acquire representative tracts suited for research and demonstration in practical forestry. Maine provided for the establishment and management of town forests, and Wisconsin made similar provision for county forests. Washington authorized the State to accept from counties tax lands suitable for State forests, Michigan provided for the retention of such lands by the State, and Minnesota set aside all State lands within the boundaries of the Minnesota National Forest as State forests. Pennsylvania made an appropriation of \$450,000 toward the acquisition of about 7,200 acres of private land in order to preserve a portion of the original forests of the State and for other forests and parks, subject to the contribution of not less than \$200,000 of private funds for the

same purposes. Maryland authorized the formation of auxiliary State forests through agreement with private landowners, and as a step toward an enlarged program of State-owned forests repealed the law authorizing Federal land acquisition for national forests.

Much of the State forest-fire legislation was revised. To cite only some of the more important cases: In Montana the State board of land commissioners may now contract with organized protection agencies for the protection of State lands, and uncontrolled or spreading fires between May 1 and September 30 are declared a public nuisance which the landowner must make reasonable efforts to abate. Oregon also reshaped its fire legislation. Delinquent fire-patrol assessments are to bear the same interest rates, costs, and penalties which apply to ad valorem property taxes. Owners or operators responsible for starting fires are also made responsible for their suppression, without regard to whether the fire spreads to other land. California, in revising her fire laws, shortened the open deer season in the Sierras, authorized closing forestry areas to campers, made the building of fires on posted lands a misdemeanor, and bettered the law concerning clearing around logging engines. Washington regulated the burning of waste material due to logging and land clearing. New York extended her intensive protective system to two additional fire towns and added a new forest-ranger district to the State organization. Nevada made provision for the organization of county fire patrols. Utah authorized the boards of county commissioners to designate fire districts, declared uncontrolled fires a public nuisance, and provided for their abatement. Wisconsin materially strengthened and enlarged its protective organization and also created an interim committee of the legislature to investigate all phases of the forestry situation in the State and formulate a comprehensive policy.

The most outstanding legislative measures, however, were aimed at encouraging the growing of timber. California, Louisiana, Minnesota, and Wisconsin amended their constitutions to permit changes in the taxation of forest lands, and Louisiana and Minnesota passed laws putting such amendments into operation. In Illinois and Washington amendments for the same purpose failed of ratification. Kentucky's forest-taxation law was declared unconstitutional by the attorney

general of the State "on the ground that the constitution prescribes that all lands shall be assessed at its true sale value, while the act sets \$2.50 as the maximum."

Especially noteworthy were the developments in Minnesota and New York. Minnesota created an interim commission to study and report to the legislature on the forestation of lands, delinquent real estate taxes, and financing counties and taxing districts in the forest areas of the State. It also directed the commission of conservation to make recommendations covering all lands owned by the State which are suitable for forestation purposes, and enacted a comprehensive measure for the forestation of lands under limited and special taxation as contemplated by the so-called "forestation amendment" to the constitution. In New York a concurrent resolution was introduced proposing an amendment to the State constitution to authorize a bond issue of not to exceed \$5,000,000 a year for 20 years, or \$100,000,000 all told, for the acquisition and reforestation of lands and the establishment of such additional forest-tree nurseries as may be needed to grow sufficient planting stock to reforest 200,000 acres each year. While this resolution was not acted upon, it is nevertheless significant that effort was begun to plan the State's reforestation work upon a scale of such proportions.

On the whole, it is evident that the States are becoming more and more alive to the importance of forestry and the necessity of progressively developing their forest policies.

COOPERATION WITH THE STATES IN FORESTRY

Cooperation with the States in forestry under the Clarke-McNary law completed its second year with appropriations that totaled \$835,000. Its object is to encourage the protection of forest and water resources and the continuous production of timber on lands chiefly suitable for that purpose. It seeks to do this by promoting permanent and adequate protection against fire of all classes of State and private forest land, whether timbered, cut-over, or burned, and of watersheds supplying water for domestic use or irrigation; by a comprehensive study of forest taxation; by supplying farmers with young forest trees for planting idle lands, windbreaks, and shelter belts; and by giving farmers advice in the proper handling of their already established woods.

The law authorizes appropriations up to the following limits:

For the prevention and suppression of forest fires, and investigations in forest taxation and timber insurance...	\$2, 500, 000
For the distribution of forest planting stock to farmers...	100, 000
For farm forestry extension...	100, 000
Total.....	2, 700, 000

The Clarke-McNary law is proving a powerful stimulus for bringing together the Federal Government, the States, and the private owners in a joint cooperative effort to promote the growing of forest crops. Forty-two of the States, in addition to the Territories of Hawaii and Porto Rico, and thousands of private owners are co-operating under one or more sections of the law.

The progress which has been made in the study of forest taxation is described on page 41; that in the other activities of the law is briefly given below.

PROGRESS IN THE STUDY OF PROTECTION REQUIREMENTS

Under section 1 of the Clarke-McNary law the Forest Service co-operates with State forestry departments, private forestry associations, or other interested organizations in studying the forest-fire protection problems of States or regions and in devising or approving programs which set forth the measures essential to permanent and adequate protection of forests against fire. The Forest Service, working with the cooperating agencies, helps to formulate the specific measures of fire protection in each forest region or State which seem essential to keep forest lands in continuous production and appear equitable to all interests concerned, assists in giving these measures publicity with a view to bringing about their general consideration, and indorses or recommends State or Federal enactments necessary to effect the application of such measures.

During the year reports dealing with the economic relationship between timber supply and forest fires and with the fire-protection measures needed were prepared in cooperation with the Florida Forestry Association and the State forestry departments of Idaho, Maine, and Montana. The published report on the Florida study was given wide distribution and undoubtedly helped to draw attention to the need for a State forestry department, which was established late in the year.

One of the most interesting and valuable projects under section 1 of the law is that in Massachusetts known as the Cape Cod forest-fire prevention experiment. Its aim is to throw light on the relative cost and value of educational preventive work for fire control as against provision for fire suppression merely. The experiment began in January, 1926, and will run three years. Cape Cod has one of the highest forest-fire hazards in the Eastern States. The project was initiated by the Massachusetts Forestry Association in cooperation with the State conservation department, the local boards of selectmen, and the Federal Forest Service.

Expenditures thus far have been 11 per cent less than under the old system of fire suppression alone, and the losses and acreage burned have been reduced by 72 per cent during two exceptionally bad fire years. The demonstration that forest fires can be prevented at reasonable cost has made the public ready to consider the next step in a reforestation program. In consequence, a joint committee representing the Cape Cod Chamber of Commerce and the Massachusetts Forestry Association is being formed to study the reforestation problem and to prepare a working plan under which the State, the towns, and the private landowners may join in the local task of reclamation and forest conservation.

In Mississippi and Oklahoma fire plans were prepared for sample protective units. They covered forms of organization, the duties of key men, methods for detecting and reporting fires, and plans for mobilizing and transporting fire crews. Of chief importance is the program of action to prevent fires through general education and the curtailment of known fire risks.

In the Southeast the fact-finding surveys begun in the previous year were conducted by State forestry departments in cooperation with the Forest Service. These surveys will eventually bring together in definite form all available information bearing upon the various phases of forest-fire protection and will enable recommendations to be framed regarding the measures necessary to meet each major protection problem. The aim is to formulate a program for each forest region or State to which all parties are agreed and for which all will strive.

PROTECTION OF STATE AND PRIVATE FORESTS FROM FIRE

Continued progress in the protection of State and private forest lands from

fire was made possible in part by a slight increase in the Federal funds available for allotment to the cooperating States, but principally by larger State appropriations and greater participation by private agencies. Yet the combined Federal, State, and private expenditures have yet to reach the half-way mark toward the estimated \$10,000,000 required annually to protect our forest lands.

Although there was no increase during the year in the number of cooperating States, Florida, South Carolina, and Delaware enacted legislation which will enable them to qualify for assistance. Of the 39 States having substantial areas of State and private forest land in need of protection, only Arkansas, Illinois, and Indiana have yet to qualify for cooperation.

A Federal appropriation of \$710,000, State funds amounting to \$1,900,000, and \$684,000 derived from private sources were available for cooperative expenditure. In addition, about \$1,500,000 was expended independently by private individuals and associations for forest protection. The latter is not included in Table 1, which shows only sums either actually disbursed by the States or expended under their direct supervision. In some of the States private expenditures which do not appear in the table far exceeded those which do. The figures given should, therefore, not be taken as indicative of the total protection effort, but merely that part of it which was made in direct connection with State systems of organized protection.

TABLE 1.—*Cooperative expenditures in fire protection and the distribution of forest planting stock under the Clarke-McNary Act, fiscal year 1927*

State	Fire protection				Distribution of forest planting stock		
	Federal	States	Private agencies	Total	Federal	States	Total
Maine	\$30,436.49	\$158,991.98		\$189,428.47	\$1,196.16	\$1,544.74	\$2,740.90
New Hampshire	8,366.41	31,473.69		39,840.10	2,280.00	5,208.00	7,488.00
Vermont	4,960.57	7,078.03		12,038.60	2,250.00	6,771.66	9,021.66
Massachusetts	14,230.00	63,543.84		77,773.84	2,510.00	7,980.38	10,490.38
Connecticut	4,440.00	28,679.67	\$806.84	33,926.51	1,145.81	1,145.80	2,291.61
Rhode Island	709.52	3,776.33		4,485.85			
New York	28,750.00	206,669.44		235,419.44	6,120.00	49,593.73	55,713.73
New Jersey	5,734.48	72,070.89		77,805.37	1,769.89	2,349.24	4,119.13
Delaware					249.99	250.01	500.00
Pennsylvania	29,120.00	106,946.02		136,066.02	5,630.00	51,218.05	56,848.05
Maryland	4,880.00	15,770.68		20,650.68	2,150.00	3,867.00	6,017.00
Ohio	2,060.00	14,174.44		16,234.44	2,800.00	15,900.75	18,700.75
Indiana					2,000.00	3,401.23	5,401.23
Iowa					2,080.00	3,000.00	5,080.00
Virginia	26,980.00	22,784.16	4,403.00	54,167.16	1,610.41	1,610.43	3,220.84
West Virginia	11,462.80	29,421.22	10,750.25	51,634.27			
North Carolina	32,943.79	31,784.57	1,159.22	65,887.58	1,700.00	1,767.98	3,467.98
Kentucky	9,500.00	8,833.43	855.27	19,188.70	2,340.00	6,398.02	8,738.02
Tennessee	15,740.51	12,109.46	3,631.07	31,481.04			
Georgia	14,920.00	9,000.22	18,499.23	42,419.45			
Porto Rico					2,508.91	10,626.82	13,135.73
Alabama	33,600.00	44,209.42	23,378.85	101,188.27	1,550.00	1,550.13	3,100.13
Louisiana	25,320.00	70,311.71	29,606.00	125,237.71	2,230.00	7,429.00	9,659.00
Mississippi	17,810.00	10,700.93	11,358.20	39,869.13			
Texas	26,580.00	28,800.50		55,380.50			
Oklahoma	8,020.00	3,889.47	20,658.43	32,567.90	903.83	903.87	1,807.70
Missouri	5,808.96	5,808.96		11,617.92	1,821.28	2,578.94	4,400.22
Michigan	37,080.00	332,519.12		369,599.12	2,250.00	6,116.62	8,366.62
Wisconsin	23,750.00	64,954.06		88,704.06	2,050.00	5,249.35	7,299.35
Minnesota	43,030.00	154,162.47		197,192.47			
Kansas					2,170.00	6,026.00	8,196.00
Nebraska					720.00	1,598.80	2,318.80
Colorado					1,703.00	1,747.90	3,450.90
South Dakota	120.00	6,663.99		6,783.99			
Wyoming					1,000.00	1,290.32	2,290.32
North Dakota					2,220.00	4,426.95	6,646.95
Montana	15,470.00	15,380.28	1,408.27	32,258.55	650.00	849.24	1,499.24
Idaho	26,280.00	97,116.55	273,415.93	396,812.48	880.00	880.00	1,760.00
Washington	35,700.00	72,171.37	111,942.54	219,813.91	2,582.00	3,182.65	5,764.65
Oregon	31,530.00	41,877.94	133,891.85	207,299.79	2,000.00	2,069.23	4,069.23
California	30,420.00	75,428.84	38,376.87	144,225.71	790.00	7,304.17	8,094.17
Hawaii					2,250.86	15,901.25	18,152.11
New Mexico	1,400.00	5,683.00		7,083.00			
Administration and inspection	60,462.28			60,462.28	3,082.47		3,082.47
Total	667,615.81	1,852,786.68	684,141.82	3,204,544.31	71,194.61	241,738.26	312,932.87
Forest tax studies	35,972.24						
Unexpended balance	6,411.95				3,805.39		
Total appropriation	710,000.00				75,000.00		

The calendar year 1926 was one of severe fires in various regions. In the Northwest and on the Pacific coast it can be compared only with the disastrous years of 1910 and 1919. In the Lake, Central, and Northeastern States a dry spring season taxed the strength of the protective organizations. In the Southeastern States both the number and the extent of the fires was again unusually large. The total number for the entire country, 91,793, was exceeded only in 1924. On the other hand, the area burned, 24,316,000 acres, and the damage to timber and improvements, \$26,912,000, were appreciably below the previous year, which was itself rather under the average in both items. It appears probable that the increasing extent and efficiency of organized protection is evidenced in the records.

With the growing public interest in the protection of forests has come a demand for more detailed information on forest fires. The increased efficiency of the protective systems made it possible to gather the statistics for 1926 in a more comprehensive fashion than previously. Table 2, therefore, shows some new features. A distinction is made between protected and unprotected lands, which permits of a fairer comparison of the records of individual States as well as between the States in the various groups. The new classification of the various types of protected lands decreases the possibility of a misconception by the public as to the character of the areas burned and extent of the damage done.

The number of fires reported for 1926, the damage caused, and the area burned in the several forest regions are shown in Table 2.

TABLE 2.—*Summary of forest fire statistics, by groups of States, for the United States, exclusive of Alaska, 1926*

Group of States ¹	Number of fires				Damage			
	On protected area	On unprotected area	Total	Per cent	On protected area	On unprotected area	Total	Per cent
United States.....	33, 867	57, 926	91, 793	100. 0	\$15, 048, 258	\$11, 864, 037	\$26, 912, 295	100. 0
Northeastern.....	6, 251	-----	6, 251	6. 8	1, 903, 983	-----	1, 903, 983	7. 1
Appalachian.....	4, 760	67	4, 827	5. 3	2, 160, 770	247, 094	2, 407, 864	8. 9
Southeastern.....	5, 244	48, 956	54, 200	59. 0	1, 469, 431	9, 771, 441	11, 240, 872	41. 8
East Mississippi.....	909	838	1, 747	1. 9	266, 110	198, 328	464, 438	1. 7
West Mississippi.....	2, 656	8, 001	10, 657	11. 6	74, 513	1, 528, 685	1, 603, 198	6. 0
Lake.....	3, 326	-----	3, 326	3. 6	980, 526	-----	980, 526	3. 6
Rocky Mountain.....	3, 911	32	3, 943	4. 3	4, 981, 648	12, 245	4, 993, 893	18. 6
Pacific.....	6, 810	32	6, 842	7. 5	3, 211, 277	106, 244	3, 317, 521	12. 3

AREA, IN ACRES, BURNED

Group of States ¹	On protected area						On un-protected area	Grand total	Per cent
	Forest land			Non-forest land	Total	Per cent			
	Mer- chant- able or mature tree growth	Unmer- chant- able or imma- ture tree growth	No tree growth at present						
United States.....	1, 039, 571	1, 681, 760	1, 394, 445	638, 853	4, 754, 629	100. 0	19, 561, 504	24, 316, 133	100. 0
Northeastern.....	51, 154	112, 452	33, 858	14, 153	211, 617	4. 4	-----	211, 617	. 9
Appalachian.....	106, 461	200, 000	129, 124	12, 763	448, 348	9. 4	55, 285	503, 633	2. 1
Southeastern.....	206, 498	492, 938	80, 685	30, 343	810, 464	17. 0	17, 438, 956	18, 249, 420	75. 1
East Mississippi.....	25, 071	88, 071	3, 143	246	116, 531	2. 5	62, 595	179, 126	. 7
West Mississippi.....	39, 853	66, 188	62, 887	5, 122	174, 050	3. 7	1, 731, 032	1, 905, 082	7. 8
Lake.....	5, 314	345, 386	314, 286	118, 694	783, 680	16. 5	-----	783, 680	3. 2
Rocky Mountain.....	188, 732	186, 698	182, 711	42, 061	600, 202	12. 6	136, 636	736, 838	3. 0
Pacific.....	416, 488	190, 027	587, 751	415, 471	1, 609, 737	33. 9	137, 000	1, 746, 737	7. 2

¹ Northeastern group—New England States, New York, and New Jersey.

Appalachian group—Pennsylvania, Delaware, Maryland, Virginia, and West Virginia.

Southeastern group—North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi.

East Mississippi group—Ohio, Indiana, Illinois, Kentucky, and Tennessee.

West Mississippi group—Missouri, Arkansas, Oklahoma, Louisiana, and Texas.

Lake group—Michigan, Wisconsin, and Minnesota.

Rocky Mountain group—Montana, Idaho, Wyoming, South Dakota, Nebraska, Colorado, Arizona,

New Mexico, Nevada, and Utah.

Pacific group—Washington, Oregon, and California.

COOPERATION WITH THE STATES IN TREE PLANTING

Twenty-five million young forest trees from the nurseries of the States cooperating under section 4 of the Clarke-McNary law were distributed to farmers during the year. The charge for the trees varied between the mere cost of packing and shipping and the cost of production. Through the use of this planting stock and trees purchased from private sources, about 30,000 acres of farm land were put on a timber-producing basis—still a negligible part of the total of idle farm lands which could be producing timber. Thirty-two States and the Territories of Hawaii and Porto Rico cooperated. Fourteen of these States did not furnish planting stock prior to the enactment of the Clarke-McNary law in 1924. Many of the States are materially enlarging their nurseries to meet the rapidly increasing demand for trees. New York led in this respect. Its nurseries will produce over 30,000,000 trees next year, of which not less than half will be used by farmers. Other States which are developing nurseries on a large scale are Pennsylvania, Ohio, Massachusetts, New Hampshire, Vermont, Connecticut, Michigan, and Wisconsin. Even in the Inland Empire, on the west coast, and in the South, where timber supplies are less depleted than in the East, the States recognize the need for assisting farmers in this work. One new State, Montana, was added to the list of cooperators, and Mississippi, Illinois, and Tennessee have requested aid under this section of the law.

The allotments made to the States cooperating and their expenditures are shown in Table 1.

COOPERATION WITH THE STATES IN FARM-FORESTRY EXTENSION

Section 5 of the Clarke-McNary law authorizes assistance to farmers in the practice of forestry. The assistance is confined to education and demonstration as contrasted with the distribution of forest trees under section 4 and is given mainly through the State extension organizations created in conformity with the Smith-Lever law. The Federal part of the work is conducted by the Extension Service of the department in cooperation with the Forest Service.

As can readily be seen, this cooperation with the States under section 5 harmonizes with that under section 4, while both are encouraged and stimulated through the cooperation in forest-fire protection which is offered

under section 2. During the year five new States included forestry in their extension programs and employed extension foresters, bringing the total number to 30. The Federal appropriation available was \$50,000, most of which was used for the employment of extension foresters.

The major activities were forest planting, windbreak or shelter-belt planting, woodland management, timber estimating, and forest protection. Forest planting on land not needed for agricultural crops continued to hold the lead. During the calendar year 1926 there were reported 3,872 planting demonstrations, involving 23,422 acres; and the planting record last spring exceeded that of 1926. The States of greatest accomplishment are naturally those where the State forester has developed a large State nursery and an effective plan for the distribution of tree stock.

Closely akin to forest planting for timber crops is the establishment of windbreaks to protect farm buildings, yards, or field crops. The Middle Western States showed the greatest activity in this direction. Nearly all the cooperating States also reported projects dealing with the care of existing woodlands.

EXPENDITURES AND RECEIPTS

The expenditures for all purposes during the fiscal year were as follows:

General administration-----	\$383, 424. 25
Protection of the national forests:	
Fire protection and detection-----	1, 723, 743. 96
Fire suppression-----	2, 772, 635. 42
Protection against insects and tree diseases-----	80, 807. 04
Total-----	4, 577, 186. 42

Administration of current business on the national forests:	
Administration of timber use-----	1, 136, 499. 42
Administration of grazing use-----	926, 837. 08
Fish and game protection-----	102, 118. 15
Administration of recreation and land use-----	191, 074. 29
Examination of power sites for Federal Power Commission-----	17, 016. 00
Total-----	2, 373, 544. 95

Surveys of lands and resources:	
General surveys and maps-----	156, 537. 30
Grazing reconnaissance-----	118, 242. 50
Timber surveys-----	271, 735. 18
Total-----	546, 514. 98

Land adjustment and extensions:	
Classification, settlement, and claims-----	\$88,309.58
Land exchanges-----	126,438.41
Acquisition under act of Mar. 1, 1911, as amended-----	1,001,290.79
Total-----	1,216,038.78
Nurseries and tree planting-----	169,262.71
Tree planting in cooperation with States under act of June 7, 1924-----	71,194.61
Construction and maintenance of improvements:	
Construction of improvements other than roads, trails, and camp-ground improvements-----	746,625.86
Maintenance of improvements other than roads, trails, and camp-ground improvements-----	662,425.14
Camp-ground improvements-----	41,072.00
Total-----	1,450,123.00
Research:	
Silvical investigations-----	358,692.44
Forest-products investigations-----	557,148.28
Range investigations-----	75,793.31
Taxation study-----	35,972.24
Total-----	1,027,606.27
Fire protection in cooperation with States under act of June 7, 1924-----	667,981.33
Protection of Oregon and California grant lands-----	77,987.30
Forestry extension-----	15,293.77
Road and trail construction and maintenance:	
10 per cent fund under act of Mar. 4, 1913-----	447,852.80
Cooperative construction of roads and trails under act of July 11, 1916-----	541,804.73
Federal forest-road construction under act of Feb. 28, 1919-----	57,959.33
Forest development roads and trails under act of Nov. 9, 1921-----	3,531,934.57
Forest highways under act of Nov. 9, 1921-----	4,949,201.17
Road and trail construction from moneys contributed by cooperating agencies under act of June 30, 1914, and Mar. 3, 1925-----	950,554.68
Contributed from other appropriations-----	456,754.42
Total-----	10,936,061.70
Grand total-----	23,512,220.05

The above statement includes not only expenditures made by the Forest Service from congressional appropriations and cooperative funds but also expenditures made by the Bureau of Public Roads for the construction and maintenance of national-forest roads.

In addition to the expenditure for land extension itemized above in the entries "land exchanges" and "acquisition under act of March 1, 1911," national-forest timber having an estimated value of \$228,318 was cut under agreements involving the acquisition of land and timber through exchange. The cash disbursements recorded under "land exchanges" cover merely the outlay incidental to examining lands offered for exchange and appraising the values involved.

The grand total shown above is \$782,876.85 greater than last year's. Of this increase, more than \$172,000 was derived from outside funds contributed for various kinds of cooperative work exclusive of road building. The agricultural appropriation act provided increases of \$24,100 for national-forest administration, \$67,980 for research, and \$75,000 for cooperation with States in fire protection and tree planting. The national-forest fire-fighting funds were greater by \$1,450,000, and a special fund of \$100,000 was provided for protective improvements in southern California. On the other hand, decreased appropriations available for roads and trails cut down the expenditures for this purpose by more than \$1,100,000.

Many of the individual expenditures shown above vary from those reported last year because of a change in the cost-accounting system. Costs are kept on the basis of activities, and to the "productive activities" are apportioned many expenditures for field and office supplies, functions of service, supervision, and the like. The prorating of these costs has in the past been in accordance with the relative money expenditures immediately chargeable to each "productive activity." In the present statement they are prorated according to relative time expenditures. This method affords a fairer picture of relative costs than the earlier method. Its most outstanding results appear in a lessened apparent expenditure on roads and trails under the final item "contributed from other appropriations" of more than \$900,000. This decrease is offset by various increases elsewhere, mainly in national-forest administration and protection.

A new item is "forestry extension," which represents educational activities of the forest force not directly contributory to national-forest administration and protection. It is exclusive of cooperative extension work, which is charged elsewhere.

The cash receipts from the national forests were as follows:

From the use of timber----	\$3, 253, 242. 50
From the use of forage-----	1, 530, 952. 46
From miscellaneous uses, including the use of land, water-power sites, etc----	382, 410. 78
Total-----	5, 166, 605. 74

The total is greater by \$10,944.72 than that for the previous year. Receipts from timber decreased \$113,-442.86. Grazing receipts were greater by \$109,363.76 and miscellaneous use receipts by \$15,023.82.

In addition to the cash receipts from timber there should be credited the value of the timber cut under specific agreements for effecting land exchanges, estimated at \$228,318.

NATIONAL-FOREST ADMINISTRATION

It is natural for those interested in the national forests to think of them in terms of a particular form of use or service. Foresters and lumbermen think chiefly of timber growing and harvesting. Stockmen think of forage utilization, and are inclined to question forms of use or development like recreation and game conservation, which may curtail the grazing of domestic livestock. Water users expect this form of service to govern. Automobile tourists want the national forests widely "opened up" with highways, and question timber cutting and other commercial developments which mar their enjoyment of public playgrounds. Other groups think of game conservation and opportunities for the wilderness type of recreation, and are against road building, hydroelectric and other water developments, timber harvesting, and grazing which would impair this form of use. The increasing pressure which results from these diverse views emphasizes the growing need for a sound correlation of land-management policies and expert planning to make the forests serve a wide variety of purposes most advantageously.

Legislation had defined as the purposes of establishing the national forests the continuous production of timber for the use and necessities of citizens of the United States and the preservation of favorable conditions of water flow. Legislation has also given the Secretary of Agriculture broad authority to regulate the use and occupancy of the national forests. These laws must be interpreted and applied to bring about the maximum of public service. The first necessity

is to protect the forests from fire and other destructive agencies. This to some degree necessitates either the curtailment of hazardous forms of use or delay in types of development that will ultimately be desirable.

Another basic starting point is that the use of range or timber can not be permitted to injure water resources or accelerate soil erosion.

On certain of the forests an acceleration of erosion with resulting silting of stream channels and irrigation reservoirs appears to be in progress. Special study is being given to determining how far this erosion is influenced by current grazing and other uses of the watersheds and what forms of special administrative control are needed to afford the most complete protection possible. The use of streams within national forests for municipal water supply is widespread; and many cities and towns are seeking special forms of protection on such watersheds, including the elimination of private land holdings and frequently the curtailment of grazing. The safeguarding of municipal water sources is regarded by the Forest Service as the paramount consideration in dealing with any area subject to this form of use; and the handling of timber cuttings, grazing, and recreation is being adapted accordingly. In this respect more complete legislative authority in regard to the operation of certain public-land laws is needed to permit forms of municipal watershed protection not now possible.

It is also a basic principle with the Forest Service that while the use of forage is one of the major forms of economic service to be provided and can for the most part be a continuing and permanent one, grazing can not be permitted to destroy or retard reforestation. This problem has critical aspects at a few points, particularly in the Southwest, where it appears probable that past grazing use has materially interfered with the establishment of pine reproduction. An aggressive attack has been made on this problem through the curtailment of grazing, the segregation of sheep and cattle ranges where dual use was formerly allowed, and the construction of range improvements which will exclude unpermitted livestock and permit much closer control of the use of the range. In this region, for example, grazing is now commonly excluded from pine areas for a considerable period of years in advance of the cutting of mature timber, in order to

encourage the establishment of young growth.

One of the knottiest problems encountered in the correlation of different uses has to do with the various kinds of outdoor recreation. Summer recreationists of all descriptions and tastes are overflowing the national forests in increasing numbers every summer. It is a wholesome and desirable use of public lands, with large social returns. A large majority of the recreation users travel by motor and want good roads, wayside camp grounds, and the public conveniences and utilities that are the usual accompaniments of this type of travel. In many instances this form of use requires not only the extension of camping facilities under safe conditions as to fire hazard but the exclusion of logging, grazing, or other commercial developments from roadside strips of timber, camp grounds, and other areas widely used for recreation. The Forest Service believes that such adjustments should be made and that certain sacrifices in the benefits derived from economic resources are warranted by the benefits derived from public recreation.

Other recreation and conservation groups wish to see large portions of the national forests withheld from road building and the structures and utilities which go with roads, and from any commercial use of timber, water, or forage, and kept as game country and wilderness spaces for the distinctive type of public service that areas left in their natural condition can render. Not infrequently this conception of recreation clashes not only with commercial developments but with motorized forms of recreation.

The Forest Service believes that this again is a matter of correlation, that within reason both forms of recreation can and should be provided in the national forests, and that far-sighted planning is necessary to assure both in fair proportion. The most immediate aspect of this problem has to do with the building of roads which are not required for the protection of the national forests or their economic development but would serve primarily to extend motorized recreation. What the future may bring forth as to the ultimate needs for timber and water and minerals in the present undeveloped hinterland of many national forests can not now be foreseen and must remain a question to be dealt with as such future requirements unfold. The building of what would be primarily recreation roads is, however, an immediate problem on many national for-

ests. While each case must be decided on its merits, the Forest Service believes it to be in the public interest to retain a substantial number of large roadless areas within which some of the most attractive, rugged, and inspiring sections of our mountain country will remain for at least a long time in substantially their natural condition. Such a viewpoint has in mind not only economy in public expenditures for road building and maintenance but the retention of some undeveloped country for its social service through wilderness forms of recreation.

All of these complex and localized problems of land management can not be handled in a practical way on the widely scattered national forests without a large degree of decentralization in their administration. The administration of each national forest must be responsive to local conditions; it must be constructive, vigorous, and prompt to act within the limits of general policies without awaiting the slow process of reference to a central office. The infinite variations in local requirements can be satisfactorily correlated and promptly met only to the degree that the local forest rangers, supervisors, and district foresters are competent, imbued with zest and enthusiasm for their work, and vested with ample latitude within which to employ their initiative and judgment. The Forest Service takes pride in the zeal for public service which characterizes its far-flung organization. To develop this spirit of interested devotion to the efficient management of great public properties is the main purpose of its scheme of organization.

Decentralized management of the national forests does not mean lack of control in essential policies; it means rather an intelligent adaptation of the policy or plan to the immediate facts dealt with in a vast business under an immense range of local conditions. The central office of the Forest Service can and does develop policies, plans, inspection, and means of determining how accomplishment compares with the standards or ideals set up. It supplies advice, general leadership, and the dissemination of knowledge of best practices. It must concern itself no less with the encouragement of incentive, interest, and initiative and with the balance which must be reached between standard practices and the freedom of the individual forest officer to get results. It must concern itself with all possible means of upholding morale and bettering the training of the field personnel. Its

objective, as a necessary phase in the correlation of varied uses, is to develop on the national forests a corps of efficient local administrators trained in productive land management, imbued with the policies and aims of the Forest Service, and intrusted with the authority and responsibility requisite to handle their own problems on the ground with a minimum of long-range supervision.

NATIONAL FOREST PROPERTIES

At the close of the fiscal year the net area of the national forests was 158,800,424 acres; the gross area, inclusive of all private and State-owned land within the boundaries, 183,938,106 acres. The net area increased 41,214 acres; the gross area decreased 185,845 acres.

Of the decrease in gross area 119,705 acres was due to recomputations based on better surveys and land data. Acts of Congress transferred to the Grand Canyon National Park 45,038 acres from the Kaibab and 7,100 acres from the Tusayan National Forest; and to the Sequoia National Park 113,562 acres from the Inyo and 121,318 acres from the Sequoia National Forest. Selections by the States of Idaho, Montana, and Washington in further consummation of land exchanges aggregated 34,325 acres. The abolition of the Upton National Forest because of other disposal by the War Department cut out 6,154 acres. Eliminations by proclamation or Executive order totaled 531,263 acres; the most important were 114,010 acres from the Florida, 46,127 acres from the Kaniksu, 170,200 acres from the Shenandoah, and 193,600 acres from the Unaka National Forest, comprising private lands found not to be purchasable or chiefly valuable for national-forest purposes.

Acts of Congress transferred 11,776 acres from the Sequoia National Park to the Sequoia National Forest, and 24,571 acres from the Grand Canyon National Park to the Tusayan National Forest. Executive orders and proclamations added 743,415 acres. The most important were 385,607 acres added to the Superior National Forest in Minnesota, 191,800 acres to the Unaka National Forest in Virginia and Tennessee, and 97,342 acres to the Ouachita National Forest in Arkansas. These lands were largely privately owned and were added to facilitate their purchase under the Weeks law. Finally, Congress added 2,851 acres to

the Colville National Forest in Washington and 9,367 acres to the Shoshone National Forest in Wyoming, following executive action under the Clarke-McNary law in respect to the classification of public lands chiefly valuable for stream-flow protection or timber production.

There are now before Congress other findings of the National Forest Reservation Commission which contemplate 10 further additions to national forests from the public domain. Detailed reports have been prepared upon 35 other areas, comprising in all 1,556,544 acres of unreserved public land, of which approximately five-sixths is timberland or woodland with a total estimated stand of 2,250,000,000 board-feet. These areas will be brought before the commission for consideration in the near future. They are lands which have no value for agriculture, and their value for grazing is subordinate to that for timber production but would be conserved and realized under national-forest administration. Practically all of them are situated within important drainage basins, and they can be administered and protected as parts of existing national forests at a minimum of expense.

PROGRESS IN LAND EXCHANGES

No land exchanges with States were completed during the year, but Michigan, Montana, Oregon, and Washington either have filed or soon will file their final lists of selected lands. Negotiations are in progress with California and Colorado. The exchange authorized with New Mexico as reported last year has not advanced beyond the stage of preliminary discussion.

The only new legislation relative to exchanges passed by Congress was an act bringing within the scope of the general exchange law all lands within 5 miles of the Black Hills and Harney National Forests in South Dakota and Wyoming.

Through 68 private land exchanges the United States acquired during the calendar year 1926, 65,582 acres in return for 23,768 acres of national-forest land and \$86,041 worth of stumpage. Thus the net national-forest area was increased by 41,814 acres. Since land exchanges began 153 have been consummated, 248,165 acres of land have been acquired, 100,202 acres of land and \$339,406 worth of national-forest stumpage have been granted,

and the net increase of national-forest area has been 147,963 acres. Much of the acquired land bears mature timber which will eventually be sold and thus correspondingly offset the initial grants of stumpage.

Including the value of both land and stumpage granted in 1926, the 65,582 acres acquired was obtained for the equivalent of \$3.17 per acre.

The Secretary of Agriculture approved and referred to the Secretary of the Interior during the calendar year 1926, 97 cases contemplating the acquisition of 135,891 acres of private land in exchange for 6,101 acres of national-forest land and 289,000,000 board-feet in stumpage.

Land prices are becoming stabilized and there is every reason to believe that the consolidation of the national forests through private land exchanges can gradually be accomplished with a moderate annual use of forest resources. The land exchange acts place no restrictions on the quantity of national-forest land or stumpage which may be employed for making exchanges, but as a safeguard against too great a use of national-forest resources for these purposes, the Forest Service limits the value of the stumpage to be thus used to 10 per cent of the gross receipts in any State during a single year, and ordinarily to 10 per cent of the timber-sale receipts alone. In the majority of the Western States the land offered now equals or exceeds what this limit allows to be immediately acquired. There will be an increasing opportunity to add desirable private lands to the national forests.

PROGRESS IN LAND PURCHASES

Title was taken under the Weeks law to 176,088 acres at an average cost of \$4.93 per acre, or a total of \$868,940.45. The average cost was identical with the average for all lands acquired in previous years. The National Forest Reservation Commission authorized purchases totaling 135,088 acres, with an obligation of \$725,731.97, or \$5.37 per acre.

The distribution by States of the lands fully acquired under the Weeks law is shown in Table 3.

TABLE 3.—*Acres of timberland acquired in the fiscal year 1927 and total acquired to July 1, 1927, by States.*

State	Acquired, 1927	Average price per acre, 1927	Total ac- quired to July 1, 1927
	<i>Acres</i>		<i>Acres</i>
Alabama.....	1,854.83	\$4.98	89,640
Arkansas.....	12,796.36	2.91	77,688
Georgia.....	34,966.04	3.90	194,945
Maine.....			32,256
Michigan.....			
Minnesota.....			
New Hampshire.....	18,375.95	13.10	427,325
North Carolina.....	151.38	4.42	364,814
Pennsylvania.....	65,276.46	4.21	214,506
South Carolina.....	3,166.10	6.11	41,042
Tennessee.....	26,711.93	3.66	322,790
Virginia.....	10,191.62	4.15	574,285
West Virginia.....	2,596.95	4.26	225,328
Total or average..	176,087.62	4.93	2,564,619

The total cost of lands fully acquired has been \$12,648,365.63.

No new purchase units were created, but a number of changes were made in the boundaries of units already established. The White Top unit was consolidated with a part of the Unaka unit, while 128,698 acres of the latter unit was made the French Broad division of the Pisgah unit. The boundary of the new Unaka unit was modified so as to exclude certain agricultural lands and to include certain forested lands needed to round out the national forest, making the present area of this unit 625,700 acres—a net decrease of 85,171 acres.

The Shenandoah, Massanutten, and Potomac units in Virginia and West Virginia were combined as the Shenandoah, and the boundaries were revised to exclude considerable agricultural land and to add certain forested areas of which much has already been approved for purchase. The new unit contains 802,700 acres, an increase of 46,186 acres over the old area. From the Monongahela unit approximately 80,000 acres were eliminated while approximately 86,000 acres were added, making the new area 740,462 acres. The Georgia unit was extended southward to take in approximately 60,000

acres, much of which has been approved for purchase by the National Forest Reservation Commission; in consequence the new area is approximately 405,866 acres.

The present purchase areas contain approximately 11,442,676 acres, including two units in the Lake States. They include 1,866,190 acres reserved from the public domain, 11,369 acres transferred from the Treasury Department under a special act, and 2,892,741 acres acquired or in process of acquisition under the Weeks law. Of the remaining 6,672,376 acres, 926,841 acres are known to possess agricultural, mineral, or water-power values which preclude purchase. The net unacquired forest lands in the existing purchase areas is therefore 5,745,535 acres. Some of it is held at prohibitive prices by the owners and some of it is already receiving such care and protection that there is no strong reason for public ownership. Approximately 380,000 acres are now under stable private management.

SPECIAL USES

At the close of the calendar year 1926, 33,065 special-use permits were in force, of which 18,237 were paid and 14,828 were issued without charge. The number of paid permits was 2,024 greater than in the preceding year and the number of free permits 241 greater. The total receipts were \$245,464—an apparent decrease of \$18,727 from the preceding year.

CLAIMS AND SETTLEMENT

During the calendar year 1926 the Forest Service submitted 265 favorable reports and 23 unfavorable reports on homestead entries and 136 favorable and 38 unfavorable reports on mineral entries. Patents were issued for 330 homestead entries and 266 mineral entries within the national forests, while 60 homestead entries and 29 mineral entries were canceled or rejected.

The twentieth year of the operation of the forest homestead law came to an end on June 11, 1926. The number of applications received during the year for the listing of land or for corrections in the classification previously made was negligible, proof in itself of the thoroughness with which the lands were classified. There were, however, many recalls of listings erroneously made in earlier years. Some such lists, after being open to entry for from 5 to 15 years, were still unentered when recalled. Others

had been entered and abandoned from two to four successive entries. The large number of unentered or abandoned listings indicates the liberality with which lands were classified as agricultural.

The fact that national-forest lands are open to unrestricted appropriation under the mining laws causes many administrative difficulties and complications. So far as the prospector and mineral developer are concerned, the creation of national forests was a help and not a hindrance, for thereby mineral lands which otherwise would have become private property were retained in public ownership and kept open for prospecting and patenting. Appreciating as it does the very great importance of the mineral resources within the national forests and the desirability of their development, the Forest Service has consistently endeavored to promote legitimate mining and to cooperate with the men engaged in it. By agreement with the Department of the Interior, all examinations of and reports upon mineral entries within the national forests are made by the Forest Service and in the performance of this duty the validity of the entries has been ascertained and reported on the basis of their conformity with the mining laws, not on the basis of the national forest values involved.

The location and entry of mineral lands within national forests by bona fide prospectors and mineral developers is entirely in harmony with the use and management of the forests for other purposes. Unfortunately there is another and totally different class of would-be users of the mining law who are seeking in increasing numbers by means of these laws to acquire very valuable national-forest lands for purposes entirely unrelated to mining. At present stumpage prices, timber values of from \$50 to \$100 per acre are not uncommon, and key tracts of national-forest land sometimes are worth from \$1,000 to \$2,500 per acre for business or recreational purposes or to control resources on large adjoining areas. Sites valuable for water-power production frequently command high prices. These attempts to get land of great market and public value through misuse of the mining laws are of great concern to the Forest Service. To safeguard the public properties, heavy outlays of time and money must be made for the examination of patently fraudulent claims and to secure their cancellation. Some remedial action is imperative. Proposals to that end were submitted to

Congress jointly by the Departments of the Interior and of Agriculture last year. Prevention of the misuse and abuse of the mining laws is fully as important to the organized mining interests as it is to the officers of the Government, and it is hoped and anticipated that their cooperation in the determination of some equitable means of meeting the situation may be obtained in the near future.

COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

During 1926 the coordinating committee on national parks and national forests made field examinations of proposed additions of national-forest lands to the Yosemite National Park in California and the Crater Lake National Park in Oregon. The preparation of the committee's reports on the proposed changes in the boundaries of these national parks largely completes its action upon the questions pending before it.

NORTHERN PACIFIC LAND GRANT HEARINGS

Upon the adjournment on June 29, 1926, of the joint congressional com-

mittee investigating the Northern Pacific Railway land grants, the representatives of the Northern Pacific and the Forest Service were requested to digest and summarize the various points covered by the 5,000 pages of testimony.

Upon a review of these digests, the joint committee decided, on account of the complexity of the questions involved, that Congress should have the advice of the Attorney General. Thereupon joint resolution of March 3, 1927 (44 Stat. 1405), extended until June 1, 1928, the inhibition against the further issuance of patents to the Northern Pacific, and directed the Attorney General to advise Congress "as to what legal or legislative action should, in his judgment, be taken in the matter of the adjustment of the said Northern Pacific land grants." The case is now being reviewed by the Attorney General.

PROTECTION FROM FIRE

The number, size, and causes of fires on the national forests in the calendar year 1926, as compared with those of the previous year and the average of the past five-year period, are shown in Table 4.

TABLE 4.—Comparison of fires on national forests, calendar years 1926, 1925, and five-year average for period 1922–1926

Classes and causes of fires	Number of fires			Percentage of total		
	1926	1925	Average, 1922–1926	1926	1925	Average, 1922–1926
Class of fire:						
Burns less than 0.25 acre	3,590	4,531	3,492	50.60	54.83	49.67
Burns between 0.25 and 10 acres	2,042	2,264	1,985	28.78	27.40	28.24
Burns 10 acres and over	1,463	1,468	1,553	20.62	17.77	22.09
Total	7,095	8,263	7,030	100.00	100.00	100.00
Causes of fires:						
Railroads	390	274	335	5.50	3.32	4.76
Lightning	3,387	5,001	3,237	47.74	60.52	46.05
Incendiarism	661	894	901	9.31	10.82	12.82
Brush burning	255	214	240	3.59	2.59	3.41
Lumbering	119	150	157	1.68	1.81	2.23
Camp fires	672	664	719	9.47	8.04	10.23
Smokers	1,282	843	1,129	18.07	10.20	16.06
Miscellaneous	329	223	312	4.64	2.70	4.44
Total	7,095	8,263	7,030	100.00	100.00	100.00

Calendar year	Total area of national forest land burned over	Total damage of national forest land burned over	Total cost fighting fires exclusive of time of forest officers
1926	Acres	Dollars	Dollars
1925	776,570	4,563,081	2,167,732
	251,102	752,851	857,516
5-year average, 1922–1926	453,356	1,504,708	1,098,368

The number of fires in the calendar year 1926 was 14 per cent less than in 1925, but the area burned was three times and the damage to national-forest land six times as large.

The reduction in number was chiefly due to fewer lightning fires. The increase in area burned and damage done was due to an unprecedented concentration of lightning fires in time and place, to extreme drouth during the season and the cumulative effect of the deficiency of precipitation during several previous years, and to inability of the organization in certain regions to cope with the severe conditions imposed upon it. More lightning fires were set on a single national forest by a single electrical storm than ever before since these areas were placed under organized protection.

The extent of the losses during the last calendar year called forth special effort to strengthen the defense. Throughout the fall and winter administrative officers in the regions affected gave much time to the study of ways to improve the organization for fire control. During the spring of 1927 the Forester personally reviewed the plans for the coming season on the ground in the four national-forest districts where serious losses had occurred. The experience and judgment of many field men were obtained, and the whole fire problem reanalyzed in the light of the previous year's record.

The season of 1926 strongly emphasized the lesson taught by previous years that catching fires small is the only way to prevent an unmanageable situation and heavy losses. But the number of fire guards which could be employed from the funds available for the season of 1927 was obviously inadequate to cope with the peak load of lightning fires possible on any one of 35 or 40 national forests especially exposed to lightning attack. Nor could the labor supply of cities where drifting labor congregates be depended upon for a quick supply of fire fighters, because too much time is required to mobilize and transport them to inaccessible points. It appeared, however, that more effective use could be made of the crews working on trail and road construction. These crews have always been of great value in fire fighting; but by carefully adjusting the periods of employment on such work to the periods of greatest fire danger and by giving special training for fire fighting to the men, it was found possible to materially increase

their effectiveness as a reserve corps of fire fighters.

Speed in surrounding a forest fire with a control line is as important as speed in reaching it. A control line is simply a cleared way, of varying width, through the timber, undergrowth, and fallen logs, with a narrow trench to mineral soil. The control line is widened by setting back-fires which spread from the trench toward the main blaze, thus increasing the chance to hold it. In heavily timbered regions it often requires from 50 to 100 men to construct 1 mile of such a fire barrier in a day, and when weather conditions are adverse or incorrect tactics have been used, the control line so laboriously constructed may easily be lost. During 1925 and 1926 it was discovered that by using a special kind of plow with a heavy horse the trenching operation could be hastened to an extent never before believed possible. A considerable number of these outfits were provided for use in 1927 as a mechanical substitute for hand labor on large fires.

Another matter emphasized by the experience of 1926 was the importance of carefully training fire guards and all other employees who can be used on fires. Some of the worst losses were due to the inability of men to find fires while they were still small. Smoke may be seen a long distance where the view is unobstructed, but when it is in dense timber and broken mountain topography a knowledge of the region and proficiency as a woodsman, as well as determination and endurance, are needed if the guard is to find his fire in time. In planning for the season of 1927, provision was made for longer and more careful training of the guard force than ever before.

When all plans had been made for the best use of available funds and equipment it was still evident that the resources were inadequate to provide against another season such as 1926. Just criticism has been leveled at the fact that whereas no expense is spared to stop fires on national forests after they become large, the expenditures to prevent them or keep them from growing large are insufficient. In the judgment of the best informed and most experienced officers, the cost of fuller preparedness to catch fires small would be much more than made up in the lessened cost of fire fighting, quite aside from the saving in devastation caused by large fires. The Forester therefore authorized expenditures during the season for needed guards,

angers, equipment, and other forms of preparedness from the appropriation for fighting forest fires, which has been drawn upon heretofore only for fire fighting and the employment of emergency guards when conditions have become acute. It was believed that the total demand on this appropriation would be less if it were used more largely for the prevention rather than the cure of big fires.

THE FIRE SEASON OF THE SUMMER OF 1927

Favorable weather in the regions which ordinarily suffer most from forest fires delayed the opening of the fire season of 1927 well beyond the usual time. Other regions were not so fortunate. In the Southwest, where spring comes early, and also in the Southern States, considerable difficulty was experienced. The southwestern district had only slightly more than half as many fires as in 1926, but the area burned was over four times as great. On the Nebraska National Forest late in the spring 23,000 acres were burned over, and a severe spring drought in the States east of the Mississippi River and south of Virginia resulted in large fires on the Alabama-Georgia and Florida National Forests. In the Pacific and Northwestern States the fires before the middle of July were small and few. In California the damage was slight until the end of July, but on July 29 lightning storms caused more than 100 fires on the Klamath, Shasta, Trinity, and Lassen National Forests in the northern part of the State. By the middle of August the area burned in and adjoining the national forests in California had mounted to 43,550 acres, of which 15,000 acres was within the forests. In the North Pacific States the same electrical storm resulted in severe losses. In Oregon and Washington many lightning fires occurred, with an unprecedented number on the Columbia National Forest, and by August 10 the area burned in national forest and near-by territory totaled 71,900 acres, of which 44 per cent was within the forests.

In the northern district, which comprises Montana and the Panhandle of Idaho, the fire losses are usually greater than in any other district. Here plentiful rains throughout the spring and summer made the task of suppression comparatively easy. The losses were negligible; although there were approximately four-fifths as many fires as in the previous year,

less than 0.6 per cent as large an acreage was burned over. While the task of protection throughout the season was incomparably lighter than in 1926, the earnestness of the organization and the benefit of the hard lessons then learned were manifested in a speed and vigor of action unparalleled before, and it is safe to say that substantial progress in methods of fire control has been achieved.

AIR PATROL

A greater value has been commonly attributed to the use of aircraft in fire control than eight years of experience has borne out. It was at first believed that air patrol would afford quicker detection of fires than could lookouts on towers and mountain peaks. This has been disproved. Nor is it surprising that relatively few first reports of fires have come from the aircraft, since any one locality is under observation only a short time during the 24 hours even if two or three patrols are made daily. Continuous observation of the terrain, such as lookout men on towers and mountain peaks have if intervening topography does not cut off a part of their view, is essential to effective fire control.

The use of airplanes after lightning storms to search out smoldering fires which might be hidden from ground lookouts by intervening ridges has as yet given disappointing results, but the possibilities of this use of aircraft have not been exhausted. Airplanes are in use in California, Oregon, Washington, Idaho, and Montana, chiefly to reconnoiter large fires. In certain instances this has proved very helpful. Where there are no ground lookout men, they are valuable also to learn whether any fires are burning and, if so, where located and how large. The difficulty of protecting national forests from fire is such that every promising method must be tried. The Forest Service plans to continue the experimental use of aircraft and thus to determine definitely their place and limitations.

THE FOREST PROTECTION BOARD

The Forest Protection Board, composed of representatives of the National Park Service, the General Land Office, the Bureau of Indian Affairs, the Forest Service, the Bureau of Biological Survey, and the Weather Bureau, was established by the chief coordinator on January 26, 1927. As

stated in the order of the chief coordinator, "The purpose of this board is to formulate and recommend to this office general policies and plans for the protection of the forests of the country, especially in the prevention and suppression of forest fires, embracing measures for the cooperation of Federal, State, and private agencies."

Following a series of 11 meetings, the board presented a report to the chief coordinator which sets forth the action necessary in its judgment to coordinate the protection of the forest lands administered by the several Federal bureaus and to effect more adequate protection of State and private forest lands under the cooperative policy laid down in the Clarke-McNary Act. This is probably the first occasion on which a coordinated picture of the forest-protection problem of all of the lands in the continental United States, under whatever jurisdiction or ownership, has been presented in a single statement.

It is the purpose of the board to continue its collaborations with a view to working out more complete cooperation and coordination in the protective work of the Federal agencies and to make mutually available the results secured in the development of protection methods.

PUBLIC AID IN PROTECTION

The enormous increase in the use of the national forests would make their protection well nigh an impossible task if the Forest Service had to carry the burden unaided. The function of the Forest Service is partly to supply leadership, guidance, and the skeleton organization necessary to enable the public to protect its own property. It makes a great practical difference whether the viewpoint is that the Forest Service is protecting Government property with Government funds or that the Forest Service and the local public are working jointly to protect the forested land on which local prosperity depends. In many regions the local communities have recognized the vital interest they have in the protection of their forests and ranges and have come to take pride in the degree to which they have prevented fires from starting or growing large. The Forest Service aims to develop local public appreciation of what the national forests mean to those living near them, and to encourage local participation, sense of responsibility, and initia-

tive in the prevention and suppression of forest fires.

In inaccessible regions, particularly where lightning fires are troublesome the Forest Service must maintain a complete organization for the sake of speed in initial action; but even here interest and support by the nearest residents is vital, especially to provide supplementary personnel to support the fighting lines when numerous lightning fires exhaust the capacity of our regular force.

MOST URGENT NEEDS FOR PROTECTION FROM FIRE

As a result of the special study of fire prevention and organization made by the Forester in March, April, and May, 1927, certain conclusions may be set forth as to the measures which are necessary if forest protection is to be sufficiently strengthened to meet the occasional extreme fire years in which the bulk of the fire expenditures and losses occur.

Vigorous development of education and cooperative measures designed to prevent man-caused fires is urgent and needed. Restrictive measures such as closing timbered areas to use and vigorous enforcement of laws pertaining to the use of fire have their place temporarily, and indeed may themselves be made effective education measures; but the problem is not solved by closing to use areas which play an important part in the social and economic life of the people or enforcing penalties after losses due to carelessness have occurred. Timidity and ignorance and carelessness which cause so large a proportion of the annual fire toll must be dealt with in a constructive way before forest-fire protection will be on a solid foundation. As forest officers and other forest-protection agents meet our farmers, lumbermen, and recreationists face to face, individually or collectively, an increasing appreciation is obtained of what it means to preserve our remaining stands of timber and bring our idle acres of timberland into production. In those relatively few communities where deliberate wood burning has been the custom for generations, individual forest officers properly equipped with mechanical aids have been able to do more in stopping fire losses by explaining the value of reforestation than scores of men could do by fighting incendiary fires.

Fire prevention is basically a matter of changing viewpoints and habits

which have grown up through many years when the supply of timber seemed inexhaustible and the re-growth of timber a thing to be fought in order that land might be used for agriculture and grazing. To accomplish so large an undertaking as the transformation of these viewpoints and habits requires not only the earnest efforts of many men but abundant aids in the shape of printed and other educational matter. The contriving and production of the needed films, posters, and other visual-educational material is no small task. It is the settled policy of the Forest Service to work for the prevention of man-caused fires by every available means, particularly through carefully devised plans for dealing with specific local situations where man-caused fires are still serious. A considerable portion of the funds now available are devoted to this activity.

Another conclusion which can not be escaped when a fact-finding survey is made on the ground is that increases are needed in the appropriations for employing guards, buying fire equipment, training fire personnel, and constructing telephone lines, lookout structures, and other improvements essential in fire control. Spending more freely in fighting big fires is worse than locking the barn door after the horse is stolen. It is economical to provide the men, the equipment, and the permanent improvements which will make it possible to cope with forest fires in their initial stages. Preparedness of this kind not only will save larger expenditures for fire fighting but also will prevent the destruction of mature timber and young growth and the conversion of productive forest land into nonproductive wastes or land growing only a partial and inferior timber crop.

A third conclusion is that under American conditions fire control is an important part of technical forestry. It calls for building up and applying specialized knowledge of the physical conditions that create a high fire danger, and still more for developing technical methods and appliances that will facilitate control. These include practicable ways and means of fire-proofing wooded areas and of constructing firebreaks, suitable machinery and equipment for use in the various operations involved, and the perfection of fire-suppression technique in every stage from the initial attack to the final mopping up after the spread of the flames has been stopped.

Similarly, there is need to develop the function of executive management

in connection with fire control. The experience of years has proved that the most important of all the factors contributing to effective control is the executive direction exercised by the responsible officer in charge on the ground. The function is essentially the same as in any other large organized effort, but it has not been developed through long use and the accumulated experience of generations, as it has in most fields of business administration. Never before have men been presented with such a forest-fire problem as is confronted in America. Efficient organization and direction of the actual field effort can not be brought about by order or a quick training course. Careful study must be made of the often obscure differences between skillful and unskillful management so that the methods which are most effective may be found and their use made general.

PROTECTION FROM INSECTS

On the national forests the most serious insect menace is bark beetles, which are always at work in coniferous forests and become epidemic when conditions favorable to their multiplication arise. In that case, unless steps are taken to check the increase of the broods, very large quantities of valuable timber may be killed. The larvae of the beetle do the killing. The adult beetle bores through the bark and lays its eggs in the soft pulpy tissue of the living inner bark, or cambium. When the eggs hatch the larvae feed in the cambium. As there are usually many larvae feeding in a tree attacked by the beetles, the effect is the same as girdling the tree.

Control of bark-beetle epidemics is brought about by felling the infested trees and peeling or burning the bark. As a rule epidemics occur in the older and therefore less-resistant stands. Ordinarily if the lumberman does not harvest the ripe timber the beetles will in course of time. Until our susceptible forests are cut over and the ripe timber harvested, a considerable loss from insect depredations will be experienced. Once the forests are placed in a thrifty growing condition, losses caused by insects as well as expenditures for control should materially decrease.

As forecast in last year's report, a large portion of the funds available for insect control was devoted to the Bitterroot-Beaverhead project in Montana. This infestation, which has been active for the last three years, is especially heavy and has spread

over a large territory. It was hoped the funds available for the fiscal year 1927 would be sufficient to clean up the infestation at points where it was likely to spread. Last fall, however, it was found that the spread had been much greater than had been anticipated, so that with the limited funds available it was thought best to concentrate all work on the Big Hole drainage of the Beaverhead National Forest. Control work was also continued on the Kootenai National Forest, another Montana project. Last year's work on this project effected a 38 per cent reduction in the number of trees infested, and the infestation is believed to be under control, but it will require further attention. There are no indications of a recrudescence of the outbreak brought under control two years ago in the Kaibab National Forest, but a close patrol will need to be maintained there for some time.

A serious epidemic in western yellow pine stands on the Colorado National Forest, in the vicinity of the Rocky Mountain National Park, was treated last spring in cooperation with private owners and the National Park Service, and about 2,000 acres of infested lodgepole pine timber on the Crater National Forest, adjacent to the Crater National Park, was also treated. The National Park Service has been fighting this epidemic inside the park boundaries for the past two years, and it became necessary for the Forest Service to carry on work within the Crater National Forest in order to prevent reinfestation of the park timber. In California small control projects were continued in the southern part of the State in cooperation with private owners. A rather serious infestation has occurred in western yellow pine on the south side of the Ashley National Forest in Utah. National-forest and Indian lands are involved. Control work was initiated last spring in cooperation with officials of the Office of Indian Affairs, and about 1,000 trees were treated.

There were numerous other infestations which should have had treatment, but lack of funds made it necessary to restrict control work to the most urgent cases. The failure of the second deficiency appropriation bill last spring necessitated the abandonment of a number of important projects and the curtailment of others.

The Bureau of Entomology continued its very effective cooperation in the prosecution of the various control projects and in furnishing advice and information along entomological lines.

The bureau has been especially helpful in carrying on cooperative studies of cut-over sale areas for the purpose of determining the classes of trees which if reserved from cutting are most susceptible to insect attack.

TIMBER

The cut of timber under commercial and cost sales for the fiscal year totaled the equivalent of 1,170,000,000 board feet. This is some 22,000,000 board feet less than for the previous year. With some fluctuations, the annual cut has been gradually increasing for more than 20 years. The decrease last year was due largely to adverse market conditions in four of the eight national-forest districts.

In addition approximately 83,447,000 board feet was cut under land-exchange agreements, as compared with approximately 36,000,000 feet cut during the preceding year. Including the cutting in satisfaction of land-exchange agreements, the total use of national-forest timber was somewhat greater in 1926 than in 1926.

Increases in timber cut are the result of a normal growth brought about largely by the development of private timber properties, which in turn have made the Government timber more accessible. It is not the policy of the Forest Service to force its timber on the market, and sales are made only after careful consideration of the necessary balance between milling capacity and the growth of the timber on the part the Government timber should play in local economic development.

As extensive liquidations of private timber investments in the Pacific Northwest, through manufacture, have been necessary during recent years, the question is occasionally raised as to the soundness of the Forest Service policy governing the sale of national-forest timber in that region. The contention is made that the Forest Service in placing large tracts of timber on the market is competing with owners of private timber who must cut to reduce their investments and carrying charges and is accentuating the tendency toward overproduction of lumber and wasteful use of a natural resource.

Sales of national-forest timber have not been a material factor in the conditions controlling the production and value of lumber. Large sales of national-forest timber are made (1) to enable established mills to continue operation, thus stabilizing the communities dependent on those mills for employment; (2) to prevent the depreciation in value of Government

timber which should be logged with privately owned intermingled timber that is being cut; (3) to aid in the development of regions or communities by the establishment of industries and transportation facilities; and (4) to harvest deteriorating timber before its value is lost to the owners, the people of the United States.

That the policy has been one of conservative development rather than of forcing the exploitation of the national forests is indicated by the fact that the annual cut of timber has increased but 178,000,000 board feet during the last five years, that it is still but one-sixth or less of the annual yield which the national forests could maintain in perpetuity, and that, although the national forests contain a fourth of the standing timber in the United States, they now furnish less than 2 per cent of the current production of lumber.

During the year an established operator was sold 62,000,000 board feet on the Harney National Forest; a sale of 154,000,000 board feet was made on the Stanislaus National Forest to an established operator whose improvements, constructed to remove his own timber, opened up adjacent Government areas; 270,500,000 board feet on the Sierra National Forest was advertised and sold to an operator whose private holdings were intermingled with Government timber; 92,000,000 board feet on the Olympic National Forest was advertised and sold to a purchaser who desired to operate the Government timber in conjunction with some 200,000,000 board feet of private timber.

The starting of a new crop while harvesting the old is an essential feature of national-forest operations. Due consideration is given in all sales to the relation the proposed cut bears to the predicted growth of the particular unit or working circle from which the timber will be removed. All cutting is done with a sustained yield of timber products as the ultimate goal.

The most notable development in the timber-sales business of the year was the award of two large pulp-wood units in Alaska, aggregating 1,670,000,000 cubic feet. The greatest importance of these awards lies not in the sales themselves but in what they mean to the development of Alaska.

These two units—the Juneau in the northern part and the Ketchikan in the southern part of the Tongass National Forest—were offered for sale after prolonged efforts to give

publicity to the proposed sales and to arouse the interest of possible bidders. The units were advertised at a price of 60 cents per 100 cubic feet for spruce pulp wood and 30 cents per 100 cubic feet for hemlock. Two bids were received for the Ketchikan unit and one for the Juneau unit. Each sale contemplates 50 years' supply of pulp wood for a large paper plant, with provision for an adjustment of the price paid the Government at intervals of five years.

These large pulp-wood sales in Alaska represent the culmination of 15 years of work by the Forest Service to get the newsprint industry extended to Alaska. The two big paper mills which will be built will mean much in the economic development of Alaska. Each project will require an investment of at least \$8,000,000 or \$10,000,000 in water-power development, manufacturing plant, and logging equipment. This primary development, requiring the employment of a large number of men, will inevitably bring about the establishment of other business enterprises. Both awardees are responsible concerns and each has received a power permit from the Federal Power Commission, with two years to qualify for a power license and to complete the preliminary steps for securing a final timber contract.

These two units are but a portion of the available power and timber resources of Alaska. It is estimated that five or six large plants, producing an aggregate of 1,000,000 tons of paper annually, can be maintained in Alaska in perpetuity. The policy of the Forest Service is to encourage the establishment of paper plants in Alaska only to the extent that they will utilize the annual growing capacity of her pulp-wood forests. To each group of water-power sites sufficient areas of timber and timber-growing land have been tentatively allotted to make possible a continuous supply of raw material through natural regeneration following cutting. In planning this permanent development of the paper-making industry in Alaska due provision has been made for holding available the timber areas needed to supply the local markets of Alaska, her fish industries, and her sawmills which are now profitably exporting high-grade lumber.

Considerable criticism of these sales has arisen, particularly in the Pacific Northwest. The economic soundness of making such large tracts of Government timber available at this time

has been questioned. The claim has been made that the Forest Service in placing these enormous virgin tracts of pulp wood on the market is in large measure making impossible the utilization of waste from logging and milling operations in Washington and Oregon, and that the development of the newsprint industry in Alaska should be postponed until the wood waste in lumber operations of the Pacific Northwest is more largely utilized for supplying the wants of the paper industry.

It is not probable that the paper-manufacturing industry anticipated in Alaska will compete seriously with the industry as it is now developing in Oregon and Washington. The spruce and hemlock of Alaska will be used in the large-scale production of newsprint, while the waste from logging camps and sawmills in Washington and Oregon may be utilized for a variety of papers and fiber boards, including newsprint but not as a major product. Generally speaking, the set-ups as to water power, quantity of raw material, marine transportation, etc., necessary to compete with the offerings in Canada for large-scale newsprint production under present conditions are to be found to a larger degree in Alaska than in the Western States. To-day over 50 per cent of the paper consumed in the United States,

or the raw material from which it is manufactured, is imported.

The Forest Service feels a special responsibility to aid in the development of Alaska. It also believes that Alaska should have the opportunity to get this industry now if economic conditions invite it. All of Alaska's more valuable coastal timber has been withdrawn in national forests, and, unlike the situation in our Pacific Coast States, there is no opportunity to create forest industries except by using national-forest resources. The Forest Service has been under fire many times for its policy of forest conservation in Alaska, which many people have regarded as a locking up of resources. It has always pointed out that, when economic conditions permit, Alaska would get her forest industries and get them under a type of development that would make them permanent. Now that the opportunity has arrived, Alaska should be helped rather than hindered in this economic development. Furthermore, as custodian of public property, the Forest Service has a responsibility to bring about the utilization of the immense quantities of mature timber now going to waste in Alaskan forests.

Tables 5, 6, and 7 summarize the national-forest-timber business for the calendar year 1926.

TABLE 5.—Quantity and value of national-forest timber sold, calendar year 1926

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>			
Alabama.....	160,000		160,000			\$360
Alaska.....	32,919,000		32,919,000	51,528		51,528
Arizona.....	98,416,000	373,000	98,789,000	222,898	\$409	223,307
Arkansas.....	5,500,000	200,000	5,700,000	39,995	200	40,195
California.....	621,316,000	2,031,000	623,347,000	1,869,304	1,396	1,870,700
Colorado.....	70,726,000	925,000	71,651,000	198,878	912	199,790
Florida.....	2,397,000		2,397,000	11,991		11,991
Idaho.....	156,935,000	4,878,000	161,813,000	373,805	4,510	378,315
Michigan.....	329,000		329,000	394		394
Minnesota.....	6,356,000		6,356,000	25,892		25,892
Montana.....	25,829,000	3,598,000	29,427,000	68,448	3,813	72,261
Nevada.....	1,112,000	387,000	1,499,000	963	351	1,314
New Hampshire.....	3,207,000		3,207,000	14,090		14,090
New Mexico.....	42,416,000	602,000	43,018,000	105,796	523	106,319
North Carolina.....	11,922,000		11,922,000	30,728		30,728
Oregon.....	105,328,000	2,228,000	107,556,000	287,125	1,492	288,617
Pennsylvania.....	4,000		4,000	40		40
South Dakota.....	73,528,000	726,000	74,254,000	259,987	732	260,719
Tennessee.....	20,045,000	113,000	20,158,000	28,409	135	28,544
Utah.....	6,657,000	1,009,000	7,666,000	10,832	1,071	11,903
Virginia.....	13,828,000	3,000	13,831,000	30,603	6	30,609
Washington.....	135,454,000	153,000	135,607,000	358,680	93	358,773
West Virginia.....	692,000	5,000	697,000	1,747		1,751
Wyoming.....	36,115,000	950,000	37,065,000	69,894	878	70,772
Total, 1926.....	1,471,191,000	18,181,000	1,489,372,000	4,062,387	16,525	4,078,912
Total, 1925.....	1,753,077,000	18,454,000	1,771,531,000	4,395,608	15,470	4,411,078

¹ In addition, minor products not convertible into board feet were sold, value \$19,655.

² In addition, minor products not convertible into board feet were sold, value \$12,146.

TABLE 6.—Quantity and value of national-forest timber cut under sales, calendar year 1926

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>			
Alabama.....	126,000		126,000	\$329		\$329
Alaska.....	55,761,000		55,761,000	90,249		90,249
Arizona.....	28,786,000	359,000	29,145,000	78,031	\$343	78,374
Kansas.....	18,550,000	102,000	18,652,000	147,270	101	147,371
California.....	319,362,000	1,955,000	321,317,000	957,009	1,211	958,220
Colorado.....	40,176,000	802,000	40,978,000	111,495	789	112,284
Idaho.....	1,921,000		1,921,000	10,544		10,544
Illinois.....	129,961,000	3,514,000	133,475,000	539,110	3,119	542,229
Michigan.....	526,000		526,000	681		681
Minnesota.....	8,271,000		8,271,000	32,507		32,507
Montana.....	28,464,000	3,947,000	32,411,000	67,271	4,220	71,491
Nevada.....	1,372,000	377,000	1,749,000	1,240	365	1,605
New Hampshire.....	4,866,000		4,866,000	24,846		24,846
New Mexico.....	8,625,000	579,000	9,204,000	18,683	487	19,170
North Carolina.....	5,804,000		5,804,000	18,543		18,543
Oregon.....	234,432,000	2,229,000	236,661,000	678,528	1,469	679,997
Pennsylvania.....	300,000		300,000	689		689
South Dakota.....	23,626,000	724,000	24,350,000	95,055	758	95,813
Tennessee.....	7,510,000	169,000	7,679,000	16,946	186	17,132
Texas.....	8,315,000	934,000	9,249,000	13,884	980	14,864
Virginia.....	9,772,000	25,000	9,797,000	26,232	25	26,257
Washington.....	181,824,000	181,000	182,005,000	407,280	108	407,388
West Virginia.....	579,000		579,000	1,632		1,632
Wyoming.....	39,521,000	926,000	40,447,000	103,083	863	103,946
Total, 1926.....	1,158,450,000	16,823,000	1,175,273,000	3,441,137	15,024	¹ 3,456,161
Total, 1925.....	1,167,468,000	15,699,000	1,183,167,000	3,320,963	13,998	² 3,334,961

In addition, minor products not convertible into board feet were cut, value \$9,526.

In addition, minor products not convertible into board feet were cut, value \$4,769.

TABLE 7.—Number of national-forest timber sales classified according to amounts of sale, calendar year 1926

State	\$500 or under, commercial sales	\$500 or under, cost sales	Total	\$501 to \$1,000	\$1,001 to \$5,000	Over \$5,000	Total
Alabama.....	31		31				31
Alaska.....	246		246	7	9	1	263
Arizona.....	903	240	1,143		2	3	1,148
Kansas.....	35	70	105	1		2	108
California.....	487	367	854	6	12	15	887
Colorado.....	464	187	651	53	10	7	721
Idaho.....	69		69	1	2		72
Illinois.....	1,074	1,663	2,737	7	13	8	2,765
Michigan.....	20		20				20
Minnesota.....	109		109	22	6		137
Montana.....	557	946	1,503	8	9	1	1,521
Nevada.....	85	133	218				218
New Hampshire.....	175		175	2	4		181
New Mexico.....	748	360	1,108	3	5	2	1,118
North Carolina.....	230		230		3	1	234
Oregon.....	460	451	911	6	8	6	931
Pennsylvania.....	1		1				1
South Dakota.....	226	92	318	6	7	3	334
Tennessee.....	320	50	370	5	6		381
Texas.....	326	561	887				887
Virginia.....	522	8	530	1	4	1	536
Washington.....	139	32	171	4	9	7	191
West Virginia.....	17	3	20				20
Wyoming.....	284	206	490	3		1	494
Total, 1926.....	7,528	5,369	12,897	135	109	58	13,199
Total, 1925.....	7,525	4,583	12,108	64	105	72	12,349

TIMBER PLANTING

Table 8 shows by States the acreage planted on the national forests for the calendar year 1926.

TABLE 8.—*Planting on national forests by States, calendar year 1926*

State	Area planted
	<i>Acres</i>
Michigan.....	4,719.60
Washington.....	1,707.00
Idaho.....	1,568.00
Colorado.....	1,252.85
Nebraska.....	1,136.67
Montana.....	1,074.00
Minnesota.....	782.38
North Carolina.....	125.00
Oregon.....	125.00
California.....	50.82
New Jersey.....	27.50
Virginia.....	23.50
New Hampshire.....	18.60
Pennsylvania.....	4.00
Kentucky.....	1.00
Total.....	12,615.92

In addition, one acre in Tennessee was sown with tree seed.

There is a striking contrast between the total of 12,617 acres which was artificially reforested in 1926 and the total acreage of 2,100,000 acres of non-productive land still in need of planting. The Federal Government is failing to reforest its lands at a reasonable rate. It is lagging behind the efforts of States and even of some private owners in this field. Public criticism of the rate at which the Government is restoring its denuded lands to productiveness, where natural regrowth can not take place in a reasonable period, is well founded. The redwood owners are planting annually more land in California than is being planted on the national forests of California, Washington, and Oregon. The States of New York and Pennsylvania are producing more trees for forest planting in their nurseries than are being produced in all the nurseries of the Forest Service for planting on the national forests. As has been pointed out in previous reports, at the present rate of planting the national forests it would take over 170 years to complete the job.

In planting, priority should be given some 650,000 acres which are of relatively high productvility and accessibility. These lands are in the East (including a number of military reservations which are also national for-

ests), in the Lake States, in the western white pine region of northern Idaho and western Montana, and in the Douglas fir belt of Washington and Oregon.

There are large areas elsewhere which, while not so highly productive, are capable of producing timber of value and the planting of which can be fully justified. In Colorado and Wyoming there is an increasing demand from cities and towns for the planting of watersheds from which municipal supplies are obtained. On the watershed of the city of Denver alone there are 55,000 acres of old burns inside the national-forest boundaries which are not restocking naturally. The city of Cheyenne has repeatedly urged that the Forest Service undertake and push as rapidly as possible planting on portions of the Medicine Bow National Forest from which it draws its municipal supply of water.

For the past 20 years the Forest Service has been carrying on a large afforestation project in the Nebraska National Forest. This project, at first largely experimental, has clearly demonstrated the feasibility of growing forests in Nebraska. There are some 170,000 acres yet to plant, and it is desirable to continue the work at the rate of about 1,200 acres annually. Climatic and labor conditions on the Nebraska forest are adverse to any large increase in the rate of planting, but eventually an important local supply of timber will be provided by this forest.

In northern California there are large brush fields occupying some of the best yellow pine and sugar pine sites. These brush fields are the result of repeated burns, and once established are very difficult to reforest. For some time to come the work of reforesting these areas will be largely experimental. Outside of these brush fields there is a comparatively small acreage which is not restocking.

The estimate of 170 years to complete the present program is in itself misleading, since it is based on the job as it exists to-day and does not take into consideration the acreage which may be added through forest fires and by the acquisition of additional lands. Were the present rate of planting on the national forests only doubled, this would make possible the reforestation of the 650,000 acres of highly productive lands in 25 years, and of some 100,000 acres of the other lands described.

RANGE

GENERAL CONDITIONS

Nothing affects the range livestock industry so much as the weather for the year. Mild or open winters and ample precipitation evenly distributed through the spring and summer are generally regarded as ideal, though winter storms are necessary to provide water for irrigation and to replenish springs and streams on summer range. In the winter of 1925-26 the precipitation in the western range States was scant, though sufficient to assure good feed on the ranges. The stock wintered well on the ranches. A very mild spring with enough moisture to provide good spring feed was followed in Colorado, Wyoming, and eastern Montana by a summer of well-distributed rains and forage conditions above normal. But on the Pacific coast, in the Northwest, and in Utah and Idaho, the summer was one of extreme drought.

In the Southwest, drought had been long continued. The season of 1926 marked its break, and, on the whole, feed conditions were better than for a number of previous years, although still under normal.

Throughout the West an extremely favorable fall was followed by a winter of heavy snows but generally favorable to the livestock industry. The surplus feed carried over from

the winter before, with that harvested during the summer of 1926, provided amply for the needs of a rather long feeding period. Large calf and lamb crops resulted from an excellent spring in 1927, and thus far the forage conditions during this year have been more favorable than at any time during the past decade.

The tendency to change from cattle to sheep mentioned in last year's report continued, but it was less pronounced and will probably be materially less during the rest of this year. The Forest Service policy has been to permit this change where the range and general economic conditions justify it. Under this policy the nonuse privilege has been granted extensively to cattle permittees where all indications pointed to their early resumption of range use. Temporarily these ranges were occupied by sheep in a large number of cases. Where ranch properties were dependent upon national forests for range which had been used for cattle grazing and the owners changed permanently to sheep, they were allowed permits for the latter class of stock. Economic conditions must to a large extent determine the policy of the service in this matter.

USE OF THE RANGE

Table 9 shows the number of livestock by classes and the number of permits for use of the national forests during the season of 1926.

TABLE 9.—Grazing permits issued and number of stock grazed on the national forests, calendar year 1926

State	Cattle, horses, and swine				Sheep and goats		
	Permits issued	Number of stock grazed			Permits issued	Number of stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Alabama.....	3	21					
Alaska.....	1	11	1			30	
Arizona.....	1,333	233,546	2,573	271	112	259,725	1,140
Arkansas.....	19	479	3	38	1		10
California.....	2,140	163,498	5,992	266	347	421,690	3,197
Colorado.....	3,143	281,647	5,851		802	955,827	606
Florida.....	9	317		5	2	455	
Idaho.....	3,047	132,323	9,607		950	1,303,092	123
Montana.....	2,111	128,243	10,523		452	566,298	87
Nebraska.....	38	9,569	649				
Nevada.....	437	58,891	2,303		109	299,406	
New Hampshire.....	25	165	16				
New Jersey.....	2	33					
New Mexico.....	1,860	92,050	3,073	180	312	210,059	10,390
North Carolina.....	107	426	42	140	19	211	
Oklahoma.....	47	2,366	235				
Oregon.....	1,254	95,292	5,222	10	434	631,283	48
South Dakota.....	581	22,626	1,691		26	17,458	
Tennessee.....	16	100			4	52	
Utah.....	4,768	121,082	4,806	168	1,915	732,663	
Virginia.....	99	1,021	3		5	127	
Washington.....	432	13,177	816		138	173,815	65
West Virginia.....	36	369	21	7	48	1,322	
Wyoming.....	787	99,606	3,970		306	639,144	
Total, 1926.....	22,295	1,456,858	57,396	1,085	5,982	6,212,657	15,666
Total, 1925.....	23,805	1,538,942	57,904	846	5,835	6,162,263	19,795

The number of cattle and horses was 82,592 less and of cattle and horse permits 1,510 less than in 1925, while the sheep and goats increased by 46,265 and the sheep and goat permits increased by 147. The total number of permits was 1,363 less.

Numbers by themselves, however, are misleading. Much of the decrease is only temporary, since the granting of the nonuse privilege for the protection of former permittees has been very general. A careful survey during the past few years has resulted in more accurately establishing the carrying capacity of most of our national-forest ranges. It is believed the figures arrived at are conservative and will hold for the 10-year permit period except in isolated cases. The number of stock actually grazed on the forests during 1926 is approximately 87 per cent of the estimated carrying capacity of the range for cattle and horses and 89 per cent of the capacity for sheep and goats.

The difference between actual use and carrying capacity is due to a number of variable factors, some of which may be attributed to a lack of demand for the more remote and inaccessible sheep ranges. The difference between actual use and permitted numbers is due mostly to permittees being unable to restock to the full amount of their established preferences. It is accounted for by a slightly smaller number per permit, which is not greater than the ordinary fluctuations due to financial, feed, market, and other economic conditions. It is believed that as soon as these conditions adjust themselves the numbers of both stock and permits will become fairly stable.

The changed grazing regulations had a pronounced effect in stabilizing the use of national-forest range, even though the number of permits and numbers of stock have declined.

Table 10 shows the number of term permits and the number of stock covered thereby.

TABLE 10.—*Term or 10-year permits, 1926*

District	Number term permits issued		Number of stock under term permits		Per cent of term permits to total		Per cent of stock to total		Total permits issued		Total stock permitted	
	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats
1.....	638	130	62,393	241,574	28.9	25.6	42.1	35.7	2,207	507	145,892	677,699
2.....	864	296	128,023	564,664	19.7	28.4	32.2	39.5	4,376	1,041	397,087	1,428,989
3.....	1,006	130	159,183	297,360	32.1	30.8	46.5	61.7	3,136	422	342,445	481,684
4.....	7,143	2,701	299,609	2,421,129	84.7	89.6	79.5	93.0	8,428	3,014	377,184	2,602,485
5.....	309	88	36,977	115,106	14.4	25.3	21.8	27.6	2,140	347	169,349	417,235
6.....	139	215	18,427	303,863	8.2	37.6	16.0	37.3	1,686	572	115,439	814,430
Total.....	10,099	3,560	704,612	3,943,696	45.9	60.3	45.6	61.4	21,973	5,903	1,547,396	6,422,522

Of all permits issued, 45.9 per cent of those for cattle and horses and 60.3 per cent of those for sheep and goats are term permits. Of the total number of stock, 45.6 per cent of the cattle and horses and 61.4 per cent of the sheep and goats are under term permits. Considering that 16 per cent of the sheep and goats and 23 per cent of the cattle and horses are under temporary permit, it appears that term permits have been applied as far and rapidly as conditions justify and the stockman desire them.

GRAZING SEASONS

Experiments and observations extended over a period of 20 years prove conclusively that the regulation of the seasonal use of national-forest range is essential to the proper maintenance of the forage. Premature use, before forage has reached its proper growth, is one of the main causes of overgrazing and range deterioration. In recognition of this principle and the fact that the greatest single factor in stability of range use is a plentiful

and permanent supply of forage, an earnest effort has been made to establish grazing seasons in conformity with the growth requirements of the vegetation. At the same time it has been recognized that adjustments in this respect must proceed in a gradual way, in order that permittees may adjust their business to meet the changes. Often the condition of the range can be improved only by either reducing the number of stock or shortening the grazing season. The former is usually more severe, since a fixed number of stock is necessary to make operation of a ranch profitable. The field officers have been called upon to review this whole question as part of the general program of stabilizing range use.

GRAZING FEES

One of the outstanding features of the past year was the settlement of the grazing-fee question. This was brought about by the Secretary of Agriculture in personal conference with representatives of the two national livestock associations in January, 1927. After meeting with representatives of the stockmen the Forester recommended to the Secretary of Agriculture:

1. That no increases in grazing fees be made during the year 1927.

2. That a schedule of maximum and minimum grazing fees for the respective national forests be approved, based upon the range appraisals of the Forest Service and the recommendations of Dan D. Casement, subject to such reductions as were found equitable to adjust fees fairly between the different national forests and regions, and to other necessary adjustments in establishing equitable fees between the different allotments on each national forest.

3. That the increases in fees called for be applied in installments of 25

per cent each during the years of 1928, 1929, 1930, and 1931, the full increase being applied during the years from 1931 to 1934, inclusive.

4. That in view of the social and economic purposes of the Forest Service in the administration of grazing and the general public benefits derived from the national forests, this schedule of fees be accepted as representing fair compensation for grazing on the respective national forests under present conditions.

5. That no changes in this schedule of grazing fees be made for the 10-year period beginning in 1935 unless there should be a material change in the conditions which affect the elements entering into an equitable determination of fair compensation for grazing on national forests.

These recommendations were approved by the Secretary of Agriculture. Final schedules under this decision are now being worked out by the Forest Service on all national forests. Under the new schedules the average fee for cattle will be increased from 10.4 cents to approximately 14.4 cents per month; and the average fee for sheep from 2.9 to about 4.5 cents.

Since 1921, when Congress authorized the waiving of grazing fees in certain sections of the West, there has been some delinquency in the payment of grazing fees. On January 1, 1926, delinquent fees in the amount of \$124,232.57 had not been collected. During the season of 1926 delinquent fees amounted to \$39,645. A large portion of this amount was collected before the beginning of the 1927 season. The amount of delinquency (less than 1 per cent) is probably far less than that suffered by private business. While it is believed that this is a fair showing, the collection of delinquent amounts is a burdensome task upon the local forest officers.

TABLE 11.—*Delinquent grazing fees, December 31, 1926*

SUMMARY BY YEARS

Year	Cattle and horses		Sheep and goats		Total		Per cent collected
	Number of permittees delinquent	Amount delinquent	Number of permittees delinquent	Amount delinquent	Number of permittees delinquent	Amount delinquent	
1921 ¹	186	\$20,993.98	27	\$2,102.49	213	\$23,096.47	70
1922 ¹	304	16,067.14	29	1,489.73	333	17,556.87	79
1923 ¹	187	13,274.15	8	173.32	195	13,447.47	84
1924 ¹	172	11,882.29	7	445.12	179	12,327.41	85
1925 ¹	493	12,647.34	70	5,511.65	563	18,158.99	55
1926.....	1,116	24,759.39	239	14,885.97	1,355	39,645.36	-----
Total.....	2,458	99,624.29	380	24,608.28	2,838	124,232.57	-----

¹ Districts 1, 4, and 5 figures as of Jan. 1, 1926, for years 1921-1925, inclusive.

TABLE 11.—*Delinquent grazing fees, December 31, 1926*—Continued

SUMMARY BY DISTRICTS

District	Cattle and horses		Sheep and goats		Total	
	Number of permittees delinquent	Amount delinquent	Number of permittees delinquent	Amount delinquent	Number of permittees delinquent	Amount delinquent
1 ¹	219	\$7,366.18	20	\$1,622.77	239	\$8,988.95
2.....	605	25,100.35	88	5,703.08	693	30,803.43
3.....	378	43,076.56	.....	.....	378	43,076.56
4 ¹	1,056	17,774.74	240	15,166.73	1,296	32,941.47
5 ¹	101	3,194.56	9	776.55	110	3,971.11
6.....	99	3,111.90	23	1,339.15	122	4,451.05
Total.....	2,458	99,624.29	380	24,608.28	2,838	124,232.57

¹ Districts 1, 4, and 5 figures as of Jan. 1, 1926, for years 1921-1925, inclusive.

RANGE IMPROVEMENTS

The importance of such range improvements as boundary, drift, and division fences, water developments, driveways, pastures, corrals, and the eradication of poisonous plants is becoming more apparent as better graz-

ing administration and range management are perfected. In fact, proper administration of the grazing resource is dependent to a large degree upon the adequacy of such improvements. The present status of these developments is best shown in Table 12.

TABLE 12.—*Range improvements constructed on national forests to December 31, 1926*

	District 1	District 2	District 3	District 4	District 5	District 6	Total
Boundary and drift fences.....miles	299	646	4,145	847	934	646	7,517
Water developments.....number	177	364	35	703	406	352	2,037
Driveways.....miles	574	1,008	.....	.....	44	93	1,719
Bridges.....number	12	14	17	.....	7	4	54
Trails.....miles	.....	.....	.....	205	26	115	346
Corrals.....number	47	68	29	96	184	84	508
Cabins.....do	.....	.....	.....	3	191	59	253
Pastures.....do	.....	.....	.....	8	415	8	431
Poison eradication.....acres	106	6,964	200	3,077	573	76	10,996
Salt troughs.....number	.....	.....	.....	25	1,492	852	2,369
Miscellaneous.....	.....	.....	.....	3	106	1,430	.....
Cost to stockmen.....	\$39,158	\$79,157	\$2,165,071	\$163,984	\$302,584	\$126,303	\$2,876,257
Cost to Government.....	92,296	97,176	132,615	123,915	41,477	27,224	514,703
Total cost.....	131,454	176,333	2,297,686	287,899	344,061	153,527	3,390,960

RANGE IMPROVEMENTS NEEDED

Boundary and drift fences.....miles	328	161	3,067	503	324	599	4,982
Water developments.....number	268	138	317	525	629	469	2,346
Driveways.....miles	574	1	.....	.....	.....	111	686
Bridges.....number	34	1	.....	9	3	18	65
Trails.....miles	19	.....	79	139	20	83	345
Corrals.....number	36	15	128	21	4	45	249
Cabins.....do	17	.....	.....	13	3	29	62
Pastures.....do	.....	.....	.....	15	42	2	59
Poison eradication.....acres	440	1,679	232,171	34,587	2,450	1,708	273,035
Salt troughs.....number	249	.....	.....	.....	1,794	1,306	3,349
Miscellaneous.....	.....	15	.....	.....	.....	1,500	.....
Cost to stockmen.....	\$27,337	\$34,016	\$326,924	\$109,906	\$46,390	\$12,478	\$557,051
Cost to Government.....	220,503	48,966	355,812	230,929	80,971	224,457	1,161,638
Total cost.....	247,840	82,982	682,736	340,835	127,361	236,935	1,718,689

¹ Acres, squirrel eradication.

DAMAGE BY RODENTS AND PREDATORY ANIMALS

Stockmen suffer serious losses every year from predatory animals, especially coyotes, wolves, and mountain lions. Game animals also suffer severely. It has been estimated that the loss to the stockmen amounts to 10,000,000 each year. The Bureau of Biological Survey of the United States Department of Agriculture wages a constant warfare upon predatory animals, cooperating with the State authorities, forest officers, and the stockmen themselves. While excellent results have followed, it has been impossible with the funds available to cover fully the vast area of country infested.

Similarly the presence of prairie dogs and other rodents on many of the forest ranges reduces seriously the forage needed for the livestock. The

Bureau of Biological Survey, in cooperation with stockmen and forest officers, has done very effective work on several national forests in Colorado, New Mexico, and Arizona during the past year, and the ranges cleared of these pests will show early improvement. This work should be materially extended.

The losses of permitted livestock during the calendar year 1926 were far less than in the previous year for cattle and horses but slightly greater for sheep and goats. In district 3 (Arizona and New Mexico) the number of cattle and horses lost decreased from 25,125 to 7,289, and for all districts from 37,250 to 18,074. District 3 likewise had much smaller losses of sheep and goats in 1926 than in 1925, with a drop from 9,033 to 3,834; but in each of the other districts there was an increase, and the total for all districts was 138,120, as against 127,704 in 1925.

TABLE 13.—Livestock losses

CATTLE AND HORSES

District	Stock lost from larkspur		Stock lost from all poisonous plants including larkspur		Stock lost from predatory animals and other causes, excluding poisonous plants		Total stock lost all causes	
	Number	Value	Number	Value	Number	Value	Number	Value
-----	167	\$8,265	196	\$9,800	708	\$28,320	904	\$38,120
-----	1,729	73,955	1,911	95,550	1,826	73,040	3,737	168,590
-----			976	48,800	6,313	252,520	7,289	391,320
-----	1,595	60,794	2,330	116,500	1,626	65,040	3,956	18,540
-----	180	4,580	318	15,900	868	34,720	1,186	30,520
-----	45	1,955	170	8,500	616	24,640	786	33,140
Total-----	3,716	149,549	5,901	295,050	11,957	478,280	17,858	773,330

SHEEP AND GOATS

			2,519	25,190	13,326	133,260	15,845	158,450
	155	1,538	2,863	28,630	14,963	149,630	17,826	178,260
			860	8,600	2,974	29,740	3,834	38,340
			11,454	114,540	58,154	581,540	69,608	696,080
			2,437	24,370	9,945	99,450	12,382	123,820
	53	477	3,309	33,090	15,316	153,160	18,625	186,250
Total	208	2,015	23,442	234,420	114,678	1,146,780	138,120	1,381,200

Total number lost, all classes of stock 155,978
 Total value, all stock lost \$2,154,530

RECREATION AND GAME

The total number of people using the national forests for recreation increased 12 per cent in 1926 as compared with 1925. Special-use permittees and their guests increased 8.5 per cent, hotel and resort guests 13.5 per

cent, picnickers 15.3 per cent, and transient motorists 14.6 per cent. On the other hand, campers decreased 3.3 per cent.

The year saw 158 camp grounds improved in whole or in part; there are now 757 with some improvements out of more than 1,500 now used heavily

by the public. The expenditures for this purpose were \$41,072. The total cost of the improvements to date has been \$199,671, of which \$42,522 has

been contributed in cash, material, or labor by private or public cooperators.

The situation as to camp-ground improvements is as shown in Table 14.

TABLE 14.—*Number of national-forest camp-ground improvements to December 31, 1926, and additional improvements needed*

Class of improvement	Total constructed to Dec. 31, 1926	Additional numbers needed	Class of improvement	Total constructed to Dec. 31, 1926	Additional numbers needed
Water supplies.....	156	541	Booths, registration, etc.....	124	562
Toilets.....	1,746	4,614	Fences, miles.....	29	78
Garbage pits.....	1,321	4,754	Clearings, acres.....	1,923	1,292
Fireplaces.....	1,073	6,193	Miscellaneous.....	2	1,600
Tables and benches.....	1,814	8,141			
Shelters.....	82	390	Total.....	8,333	28,338
Footbridges.....	63	178			

To complete the improvements listed above would cost approximately \$515,000. Practically all of the 1,500 areas used heavily for camping purposes by the public would then be reasonably supplied with simple conveniences, while camping would be concentrated where the fire risk is low and the presence of campers does not menace the purity of the water supplies of communities.

Every effort is being made by the Forest Service to eliminate insanitary conditions upon national-forest lands, but upon some areas unsatisfactory conditions still exist.

The national forests are rich in resources of very great value for other than purely material purposes. As our population grows and land use becomes more intensive, there will be an increasingly felt need for wilderness areas where refreshment of body and spirit may be obtained in the surroundings of unspoiled nature, and where the choicest features of our great mountain regions may be enjoyed in all of their native beauty and grandeur. It is not too soon to give thought to future social requirements along these lines and to make definite provisions for them, in due measure, as a part of the planning necessary for the orderly development of forest resources and the realization from them of the maximum public benefits.

It will, therefore, be the aim to keep substantial portions and some of the outstanding scenic features of the national forests available for forms of recreation impossible where automobile roads, commercial enterprises, and other popularizing facilities for use are encouraged. Excluding Alaska, one-third of the gross area of the national forests is in roadless areas of 10 townships (that is, 230,000 acres) or more each; and even when the road-and-trail program now mapped out is completed, more than one-fourth will be in such areas. This will not prevent the orderly use of timber, forage, and water resources as future needs may dictate. It will, however, prevent the unwise destruction of recreational values which are steadily attaining greater social significance and importance. The Forest Service plans to withhold these areas against unnecessary road building and forms of special use of a commercial character which would impair their wilderness character.

Game administration is occupying a more important place in forest administration as the problems involved are more clearly perceived and as forest officers continue to study the requirements of wild life and develop the plans necessary for its protection and perpetuation. Table 15 shows the latest estimate of game animals on the national forests:

TABLE 15.—*Number of big game animals and beaver on national forests; estimates as of December 31, 1926*

[Summary by States]

State	Antelope	Bear		Caribou	Deer	Elk	Moose	Mountain goats	Mountain sheep	Beaver
		Black or brown	Grizzly							
Alaska.....		15,900	25,000		57,300		2,050	9,000	2,600	
Alabama.....					100					
Arizona.....	1,971	601	14		59,368	758			239	72
Kansas.....					1,150					
California.....	526	10,894			236,660	131			775	219
Colorado.....	164	2,704	18		26,115	8,295			3,888	45,275
Florida.....		20			610					
Iaho.....	1,745	5,064	133	64	60,105	6,840	737	3,042	1,276	15,110
Michigan.....		31			225					
Minnesota.....		725		3	4,365		1,075			4,208
Montana.....	917	5,375	441	6	51,487	10,593	1,185	4,248	1,796	16,060
Nebraska.....					50					
New Hampshire.....		525			2,530					
New Mexico.....	961	664	19		25,027	85			200	811
Nevada.....	107	41			5,340				175	175
North Carolina.....		80			3,204	30				
Oklahoma.....	22				250	300				
Oregon.....	47	6,215	2		71,339	4,471			40	5,619
Pennsylvania.....		200			1,050	15				25
South Dakota.....					2,370	547		3		2,763
Tennessee.....		27			65					
Tah.....	15	368	16		24,891	1,715			247	7,846
Virginia.....		450			30	100				
Washington.....		6,420	35	101	26,320	9,590		2,125	10	9,111
West Virginia.....		100			30					
Wyoming.....	467	1,461	136		11,069	39,008	2,145		2,639	8,382
Total.....	6,942	47,865	5,814	174	671,050	82,478	7,192	18,418	13,285	115,676

¹ Black bear only.² Including Alaska brown bear.

This estimate raises the deer population by approximately 65,000 head, the elk by over 10,000, and moose by approximately 1,000, while mountain goats and mountain sheep show little change. In many localities better provision for their protection should be made.

Elk are now found on 95 national forests, in numbers ranging from 1 head on the Chelan to approximately 9,000 on the Teton. Each of the larger herds represents a special problem. The carrying capacity of the range should govern the extent to which the herds are allowed to increase. Good game administration calls for determining the limit thus imposed and the best means of holding the herd within it. Such a course requires the closest cooperation of State, sportsman, and Federal agencies.

In line with this conception, the chairman of the President's committee on outdoor recreation called a meeting during the latter part of March of all agencies interested in the Jackson

Hole elk herd. After a thorough discussion plans were formulated for meeting the critical situation which occurs at periodic intervals with this herd. It is believed the plans then formulated will solve this problem. The field officers of the Forest Service continued to study the conditions influencing the welfare of the northern Yellowstone elk. Particular attention was given to the development of a plan for the acquisition of the private holdings within the area north of the Yellowstone National Park, which, as a means of protecting the elk and antelope, was added to the Absaroka and Gallatin National Forests by the act of Congress approved May 26, 1926.

Forest officers referred to State officials for prosecution 617 game law cases which resulted in 347 convictions. Under "Forest Service cases," 201 cases were investigated, which resulted in 102 arrests and 99 convictions.

Forest officers also issued 7,286 State game licenses and examined 22,286. This form of cooperation has increased

the respect for game laws and has aided State officials materially in the protection of wild life.

The deer herd on the Kaibab National Forest continues to present a difficult problem; but the prospect for its solution was decidedly improved when at the close of the fiscal year, the United States District Court for Arizona, northern division, entered a decree sustaining the right of the United States to prevent further damage or injury by the deer to the Kaibab National Forest and Grand Canyon National Game Refuge. The decree enjoins the State and county officers from enforcing the game laws of Arizona against officers, agents, servants, or employees of the United States engaged in carrying out the regulations or orders of the Secretary of Agriculture for reducing the number of deer and for removing them or their carcasses to places within or without the State. The decree stipulates, however, that it shall not be construed to permit the licensing of hunters to kill deer within the forest or preserve in violation of the game laws of the State.

The canyons and deserts which surround the Kaibab Forest preclude the migration of excess game to other regions. The 4,000 deer estimated as on the area when it was made a game refuge in 1906 have grown to a herd of approximately 30,000. Although progressive reductions have been made in the numbers of cattle and sheep permitted to graze on the forest until only a negligible number now use it, the entire area is overgrazed and upon about one-half of it the damage to tree growth and undergrowth threatens the future of the forest. The deer so far exceed the normal capacity of their range that they are forced to subsist destructively upon the young trees and shrubs; and it is estimated that since November, 1924, 10,000 deer have starved. A bad season might result in the almost total extinction of the herd.

Extended study, accomplished in part by a committee of game experts of national reputation, has demonstrated that the only feasible means of protecting either the forest or the game is to reduce materially the number of deer. The State of Arizona was authorized to drive 5,000 deer to other regions, but the attempt proved wholly impracticable. Efforts to ship first adult deer and later fawns to other localities in any large numbers also proved impracticable. Controlled killing of the excess deer is the only way

left to avert the damage to the forest and the growing menace to the herd.

The game laws of Arizona allow hunting only during the month of October and the killing of only one male deer; while they prohibit transportation of carcasses from the State and impose a charge of \$20 upon non-residents. Adequate reduction in the number of deer would obviously be impossible under these limitations. The Secretary of Agriculture authorized by regulation the killing of not to exceed three deer per hunter under cooperative agreement with the Forest Service, with a hunting period of two months and a charge of \$5 per deer. The Governor of Arizona, however, directed the State officers to apprehend and prosecute all persons hunting in violation of the State game laws. This forced resort to the courts. The United States sought a restraining order upon the ground that both the lands within the game refuge and the deer thereon were the property of the United States, which therefore had the right to kill and possess the deer, to transport them outside its own lands and outside the State of Arizona, and to delegate its rights to persons cooperating with it. The court declined to pass upon the question of ownership of the game; but its decree practically confirms all of the contentions of the United States except that of the power to delegate to hunters the right to kill and remove the deer.

WATER POWER

Table 16 shows the status on June 30, 1927, of water-power permits granted by the Department of Agriculture under the provisions of the acts of February 15, 1901, February 1, 1905, and March 4, 1911. The number of permits outstanding on June 30, 1927, was 26 less than at the end of the preceding fiscal year. This reduction was due in part to the abandonment of proposed power development. In large measure the remaining relinquishments were due to the redesign of the power projects, necessitating more land and permits or licenses from the Federal Power Commission.

The Federal Power Commission requested the Forest Service to make field investigations and reports in 46 cases and to supervise and inspect the operations of 51 permittees or licensees. Fifty-eight reports were made during the year and at its end the Forest Service was supervising operations in

7 cases. Of the 97 applications received by the Federal Power Commission during the year, 50 involved the use of national-forest land.

TABLE 16.—*Water-power development and transmission-line rights of way under permit or easement, fiscal year 1927*

Class of permits or easements	Transmission lines only			Power projects (reservoirs, conduits, and power houses)		Total permits or easements
	Number of permits or easements	Length in miles		Number of permits or easements	Estimated average output at minimum discharge (horse-power)	
		Within national forest boundaries	On national forest land			
Permits or easements in force at close of fiscal year:						
Rental.....	125	962.26	716.66	63	543,253	188
Free permits or easements.....	22	155.40	127.83	68	26,272	90
Total.....	147	1,117.66	844.49	131	569,525	278
Construction completed at close of fiscal year:						
Rental permits or easements.....	125	962.26	716.66	59	365,419	184
Free permits or easements.....	22	155.40	127.83	64	26,202	86
Total.....	147	1,117.66	844.49	123	391,621	270
Construction incomplete at close of fiscal year:						
Rental permits or easements.....				4	177,834	4
Free permits or easements.....				4	70	4
Total.....				8	177,904	8

From the standpoint of the national forests the most important water-power action during the year was the granting of two preliminary permits for power development in the Tongass National Forest in Alaska. One of these involved Long and Crater Lakes and their outlets and the other a continuation of nine different projects in the vicinity of Ketchikan. The power capacity in each case is large. The primary purpose of development is the manufacture of wood pulp. These cases were handled in accordance with the policy approved by the Forest Service and the Federal Power Commission several years ago, to coordinate action so as to make Alaskan power and timber available to the applicant presenting the most desirable project for their joint development. The Forest Service had previously located a unit of timber supply to each group of power sites. Upon receipt of applications for the timber, was advertised for sale and the successful bidder was granted a preliminary power permit.

These proposed power developments are noteworthy not only because of their effect on the welfare and growth of southeastern Alaska and the utilization of national-forest resources but because the utilization of one resource—power—is based entirely on utilization of another resource—timber.

Future power development in Alaska was aided by the airplane-photography expedition of the United States Navy. Planning of one of the two large developments mentioned in the preceding paragraphs was based very largely on topographic conditions brought out by the Navy photographs. Not as many undiscovered power sites were revealed as had been hoped, but it is believed that further sites will be found as the work covers additional portions of the national forests.

It is regretted that conditions prevented completion in 1927 of all the photographic work on the Tongass Forest. Its completion in the summer of 1928 is hoped for. To date some 5,000 sets of three pictures each are available. Making prints of these was

a tremendous undertaking and is not yet completed. The Geological Survey has begun the preparation of a map based on the photographs, which will be of immense value to the Forest Service and to users of the Tongass Forest.

ROADS AND TRAILS

The accomplishments in and the expenditures made for forest road and trail construction and maintenance in the various States containing national forests are given in Table 17.

TABLE 17.—Construction, improvement, and maintenance of roads and trails from forest road appropriations and other Federal and cooperative funds by States, June 30, 1927

State	Fiscal year 1927				Total to June 30, 1927		Expenditure to June 30, 1927			
	Constructed		Maintained		Constructed					
	Roads	Trails	Roads	Trails	Roads	Trails	Federal funds	Cooperative funds	Total	
	Miles	Miles	Miles	Miles	Miles	Miles				
Alabama	3.6		22.0		10.1		\$50,987.59	\$1,982.65	\$52,970.24	
Alaska	23.6	42.4	156.5	270.6	186.6	270.6	3,071,994.25	237,573.17	3,309,567.42	
Arizona	134.5	56.3	815.4	646.8	822.6	1,397.3	3,717,018.41	826,798.24	4,543,816.65	
Arkansas	61.6	29.0	118.0	337.2	341.4	478.1	773,631.39	24,647.73	798,279.12	
California	121.3	224.7	2,241.2	5,064.5	1,285.9	2,392.8	9,058,748.43	3,075,678.10	12,134,426.53	
Colorado	84.7	719.4	668.3	7,473.4	1,058.2	3,309.7	4,716,255.73	741,976.24	5,458,231.97	
Florida	15.5		170.8	36.5	125.6		241,099.56	136,311.18	377,410.74	
Georgia	13.3		56.6	168.6	32.8	168.6	278,886.61	923.60	279,810.21	
Idaho	146.8	978.5	2,073.6	8,709.7	1,672.8	6,011.4	9,491,792.39	1,440,116.33	10,931,908.72	
Illinois							4.00		4.00	
Kansas					3.4		2,111.51		2,111.51	
Kentucky							33.10		33.10	
Maine	.3		3.8	40.8	5.3	40.8	24,185.88		24,185.88	
Maryland							5.52		5.52	
Michigan	.2		40.0		22.2		14,301.07	393.45	14,694.52	
Minnesota	63.2	19.5	143.5	64.0	293.6	103.2	444,687.16	232,717.59	677,404.75	
Montana	69.0	710.8	1,010.7	6,389.0	854.0	2,930.1	5,881,616.86	547,237.61	6,428,854.47	
Nebraska	5.0		20.7		46.3		68,636.66	990.80	69,627.46	
Nevada	32.1	13.5	319.1	306.0	423.0	765.0	1,027,040.19	128,933.16	1,155,973.35	
New Hampshire	2.5	33.8	33.8	330.2	35.0	330.2	201,342.47	5,765.17	207,107.64	
New Jersey							15.37		15.37	
New Mexico	75.6	70.5	429.2	950.0	592.0	1,287.0	2,844,364.21	243,551.09	3,087,915.30	
New York							13.06		13.06	
North Carolina	19.5	3.0	149.5	568.3	171.2	568.3	526,638.78	50,054.94	576,693.72	
North Dakota					1.0		57.75		57.75	
Oklahoma	.2		29.4		24.7	16.5	46,293.43	10,513.61	56,807.04	
Oregon	226.0	806.0	3,461.4	6,491.0	2,098.8	3,218.8	8,765,976.61	5,059,539.66	13,825,516.27	
Pennsylvania	8.0		83.0		42.0		40,146.07	1,005.00	41,151.07	
Porto Rico	1.0			36.3	1.0	36.3	14,059.34	550.00	14,609.34	
South Carolina			16.9		16.3	4.0	73,458.69	3,462.71	76,921.40	
South Dakota	22.0	5.2	145.6	50.0	241.1	53.2	601,979.17	172,891.01	774,870.18	
Tennessee	3.7	14.5	47.8	436.1	82.0	450.6	259,880.75	129,572.16	389,452.91	
Utah	67.0	417.3	656.0	1,388.8	957.7	2,825.1	2,567,498.44	699,083.39	3,266,581.83	
Virginia	10.3	3.5	60.7	603.6	111.6	682.1	408,717.29	36,657.43	440,374.72	
Washington	67.1	476.6	879.7	6,069.0	746.4	2,204.2	5,552,677.18	1,451,627.39	7,004,304.57	
West Virginia	9.7	14.2	38.7	253.5	42.9	354.8	104,356.10	3,242.91	107,599.01	
Wyoming	82.4	348.6	701.7	3,982.7	871.0	1,708.5	3,123,996.30	348,159.95	3,472,156.25	
Total	1,369.7	4,987.3	14,593.6	50,666.6	13,218.5	31,607.2	63,989,507.32	15,611,956.27	79,601,463.59	

The apportionment among the States of the fiscal year authorization and of the total appropriations and au-

thorizations, and the condition of these road appropriations July 1, 1927, are shown in Tables 18 and 19.

TABLE 18.—*Distribution among the States of the total appropriation and of the apportionment for the fiscal year 1928*

State	10 per cent fund		Section 8 fund	Federal forest road construction fund
	Fiscal year 1928	Total	Total	Total
Alabama.....	\$84.44	\$610.94	\$15,456.04	\$1,922.31
Alaska.....	16,772.58	133,175.77	467,677.05	192,760.71
Arizona.....	22,941.49	500,533.07	602,270.53	502,219.41
Arkansas.....	10,826.60	88,877.93	174,939.40	129,268.41
California.....	116,575.10	1,075,415.33	1,458,839.48	1,199,453.89
Colorado.....	40,237.77	551,399.80	757,397.81	778,160.67
Florida.....	3,058.91	28,591.10	119,528.14	22,001.25
Georgia.....	1,133.94	7,343.92	51,184.94	134,437.03
Iaho.....	54,521.28	714,567.86	1,192,821.16	1,368,155.19
ansas.....		1,867.27		
entucky.....	326.39	492.49		
aine.....	221.16	2,009.34	32.41	3,738.77
aryland.....	55.05	55.05		
ichigan.....	183.76	1,127.96	7.00	3,000.00
innesota.....	4,812.67	28,968.12	7,928.63	108,237.34
ontana.....	20,529.16	493,055.41	751,906.10	731,615.64
braska.....	1,112.88	15,615.26	18.98	
evada.....	9,377.99	139,292.79	194,631.77	82,413.97
ew Hampshire.....	2,929.25	25,727.63	341.66	10,857.64
ew Jersey.....	33.50	48.82		
ew Mexico.....	12,755.86	298,230.94	429,092.69	509,977.19
orth Carolina.....	2,011.99	26,295.50	84,556.25	177,013.35
orth Dakota.....		45.75	7.00	
lahoma.....	575.06	7,817.81	65.49	2,775.17
regon.....	75,717.56	734,627.86	1,425,679.58	1,075,674.15
nnsylvania.....	-46.10	247.28	24.04	21.42
orto Rico.....		3.70	7.00	3,343.09
uth Carolina.....	363.62	1,268.24	402.10	48,150.05
uth Dakota.....	11,569.92	123,980.11	83,388.00	79,721.47
ennessee.....	1,413.27	14,384.67	78,254.65	28,154.47
ah.....	18,649.70	320,654.58	444,880.79	465,678.07
rginia.....	3,513.52	28,985.52	58,101.01	72,065.82
ashington.....	60,920.14	423,147.56	937,858.25	714,414.12
est Virginia.....	421.27	3,327.07	12,830.41	5,049.24
oming.....	20,440.95	324,788.15	470,544.67	548,767.92
adistributed.....			179,326.97	952.24
Total.....	514,040.68	6,116,580.60	10,000,000.00	9,000,000.00

State	Forest highway fund		Forest road development fund		Grand total
	Appropriated and authorized, fiscal year 1928	Total	Appropriated and authorized, fiscal year 1928	Total	
Alabama.....	\$3,954.00	\$20,123.00	\$6,979.00	\$32,276.00	\$70,388.29
Alaska.....	472,547.00	3,102,059.00	20,562.00	156,338.00	4,052,010.53
Arizona.....	279,246.00	1,868,831.00	135,777.00	913,299.00	4,387,153.01
Arkansas.....	34,472.00	223,353.00	50,464.00	297,566.00	914,004.74
California.....	680,140.00	4,572,028.00	423,834.00	2,640,400.00	10,946,136.70
Colorado.....	335,131.00	2,252,070.00	145,576.00	1,146,240.00	5,485,268.28
Florida.....	12,071.00	75,930.00	23,491.00	81,175.00	327,225.49
Georgia.....	11,648.00	56,803.00	21,997.00	99,943.00	349,711.89
Iaho.....	509,561.00	3,423,813.00	636,277.00	4,155,913.00	10,855,270.21
Illinois.....	390.00	781.00	206.00	396.00	1,177.00
Indiana.....					1,867.27
Iowa.....	1,608.00	3,218.00	1,832.00	5,064.00	8,774.49
Kansas.....	1,272.00	8,535.00	1,204.00	11,854.00	26,169.52
Maryland.....	352.00	704.00			759.05
Michigan.....	2,383.00	14,422.00	11,430.00	54,159.00	72,715.96
Minnesota.....	29,302.00	197,579.00	34,889.00	272,665.00	615,378.09
Montana.....	403,447.00	2,724,482.00	288,252.00	2,261,937.00	6,962,996.15
Nebraska.....	4,661.00	33,531.00	1,193.00	25,667.00	74,832.24
Nevada.....	96,603.00	650,489.00	4,499.00	98,873.00	1,165,700.53
New Hampshire.....	16,437.00	108,892.00	13,821.00	92,679.00	238,497.93
New Jersey.....	837.00	1,674.00	411.00	791.00	2,513.82

TABLE 18.—*Distribution among the States of the total appropriation and of the apportionment for the fiscal year 1928—Continued*

State	Forest highway fund		Forest road development fund		Grand total
	Appropriated and authorized, fiscal year 1928	Total	Appropriated and authorized, fiscal year 1928	Total	
New Mexico.....	\$210,424.00	\$1,422,383.00	\$116,239.00	\$733,615.00	\$3,393,298.00
New York.....	705.00	1,411.00	514.00	970.00	2,381.00
North Carolina.....	14,098.00	90,052.00	34,742.00	190,061.00	567,978.00
North Dakota.....					52.00
Oklahoma.....	2,109.00	16,294.00	359.00	21,955.00	48,907.00
Oregon.....	579,801.00	3,805,734.00	537,103.00	3,111,717.00	10,153,432.00
Pennsylvania.....	5,492.00	15,761.00	9,162.00	46,179.00	62,232.00
Porto Rico.....	597.00	4,356.00	306.00	11,561.00	19,270.00
South Carolina.....	2,199.00	8,454.00	5,194.00	33,934.00	92,208.00
South Dakota.....	35,263.00	238,517.00	19,224.00	151,407.00	677,013.00
Tennessee.....	11,677.00	66,647.00	15,919.00	102,019.00	289,459.00
Utah.....	172,562.00	1,160,066.00	48,128.00	460,193.00	2,851,472.00
Virginia.....	17,287.00	96,342.00	28,560.00	179,017.00	434,511.00
Washington.....	325,485.00	2,208,795.00	277,595.00	2,251,005.00	6,535,219.00
West Virginia.....	5,311.00	28,525.00	18,817.00	80,403.00	130,134.00
Wyoming.....	220,928.00	1,497,346.00	65,444.00	778,729.00	3,620,175.00
Undistributed.....					180,279.00
Total.....	4,500,000.00	30,000,000.00	3,000,000.00	20,500,000.00	75,616,580.00

TABLE 19.—*Condition of forest road funds on June 30, 1927*

Fund	Total appropriations	Total expenditures	Unexpended balance
10 per cent.....	\$5,602,539.92	\$5,207,229.18	\$395,310.74
Section 8.....	10,000,000.00	9,361,511.26	638,488.74
Federal forest road construction.....	9,000,000.00	8,955,611.57	44,388.43
Forest highway.....	25,500,000.00	22,848,334.31	2,651,665.69
Forest road development.....	17,500,000.00	16,210,686.48	1,289,313.52
Total.....	67,602,539.92	62,583,372.80	5,019,167.12

TABLE 20.—*Forest highway and forest road development funds appropriated for fiscal years 1922 to 1927, inclusive*

Fiscal year	Forest highway fund	Forest road development fund	Fiscal year	Forest highway fund	Forest road development fund
1922.....	\$2,500,000	\$2,500,000	1925.....	\$3,500,000	\$3,000,000
1923.....	7,000,000	3,000,000	1926.....	4,500,000	3,000,000
1924.....	3,500,000	3,000,000	1927.....	4,500,000	3,000,000

The amount of forest highway and forest road development funds actually appropriated for each fiscal year is shown in Table 20.

At the close of the fiscal year the transportation system planned as necessary within 10 years for the protection, utilization, administration, and development of the national forests

comprised 51,268 miles of road and 110,385 miles of trails. To complete will require an estimated expenditure of \$177,124,616. Considering the large area of the national forests the system is not intensive. The classification and status of the mileage and the estimated expenditures are shown in detail in Table 21.

TABLE 21.—*Classification of road mileage and estimated expenditures*

System	Total	Satisfactory	Unsatisfactory	Non-existing	Expenditures required to complete
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	
Forest highways.....	15,068	5,084	8,687	1,297	\$123,916,067
Forest development roads.....	36,200	10,910	14,767	10,523	47,528,558
Trails.....	110,385	73,431	12,461	24,493	5,679,991
Total.....					177,124,616

The average annual expenditure from the forest highway and forest road development funds for the past three years has been approximately \$8,400,000. The expenditure program for the fiscal year 1928 is \$7,500,000, although a larger amount is available for obligation. Assuming that no increase in mileage will be made in the system as now planned and that the present proposed standards and estimated costs do not vary, an annual appropriation of \$4,500,000 for forest highways and \$3,000,000 for forest development roads and trails would permit the completion of the road system within 31 years and of the trail system within 8 years. On the other hand, the public will doubtless demand a larger mileage as more intensive use is made of the forests.

MAPS AND SURVEYS

There were printed 25 maps on the scale of one-fourth inch to the mile and 17 maps on the scale of one-half inch, incorporating the results of Forest Service surveys and other data. There were also issued an index map of the United States showing all the national forests, State forests, national parks, national monuments, and Indian reservations, seven proclamation diagrams, and an eight-page atlas folio. Numerous small maps, charts, and illustrations were lithographed.

In Idaho, Montana, Utah, and Washington approximately 2,100 square miles of virgin forest land were mapped for drainage. These surveys were based on accurate data and only differed from a regular topographic survey in that vertical control was not extended and contour lines were not delineated. A triangulation net extending over approximately 1,000 square miles of the Tonto National Forest in Arizona was surveyed to the standards prescribed by the Federal Board of Surveys and Maps.

The phototopographic survey made by the Navy Department by airplane

embraced practically all of southeastern Alaska except Baranof and Chichagof Islands. The photographs were taken at an altitude of approximately 10,000 feet, and are on a horizontal scale of approximately 1,660 feet to the inch. Arrangements have been made with the Navy Department and the Geological Survey whereby prints of these photographs may be purchased by the public. The map that is being compiled by the Alaskan branch of the Geological Survey from these photographs will be on a horizontal scale of 1:180,000, or approximately 15,000 feet to the inch.

In connection with the aerial fire patrol in Idaho, an aerial photographic survey covering about 64 square miles in the Kaniksu National Forest was conducted for experimental purposes. A K-3 single-lens camera was borrowed from the Army Air Corps. The area was photographed from an altitude of approximately 10,000 feet. A serviceable mosaic map on the scale of 6 inches to the mile was made from the photographs.

Numerous small projects involving timber, grazing, and land-exchange areas were topographically surveyed.

The General Land Office surveyed approximately 150 townships within or partly within the national forests, but the Geological Survey has made little progress in mapping national-forest lands since the passage of the Temple Act. Fifty-four per cent, or about 99,000,000 acres, of the national forests are without accurate topographic surveys. These surveys constitute an essential administrative tool in connection with proper development and utilization of forest resources and efficient fire protection. The urgency for extending them can hardly be overstressed.

RESEARCH

The size and complexity of the task of research in connection with forestry becomes more evident the more closely

it is approached. The problems to be solved are of almost infinite number and diversity. They go far deeper than the development of the most economical and profitable methods of growing timber and utilizing forest products. They necessitate fundamental research in the various natural sciences which relate to soils, plant life, and the organic substances which forests supply; they necessitate thoroughgoing industrial research that will make possible the best adjustment between our forest resources and our manifold requirements; and they necessitate economic research aimed at the whole great problem of land use, from the standpoint of present and future national needs.

For the forest problem can not be isolated from the rest of our land problem and worked out separately. The various forms of land use interlock. Of our nearly 3,000,000 square miles of land area all but a wholly insignificant fraction must make its contribution to the Nation's life as tilled land, grazing land, or forest land. How shall the line between these be drawn? Increase of population will put increasing pressure on the land, both for food and for the raw materials of industry. How to bring about on all the land the kind and method of use that will be most advantageous in the long run is the most vital material problem confronting the country. Well-directed research will enable us to advance on the right road. It will enable us to obtain dependable knowledge of what land should be employed in forest crops, of the effect of present practices upon timber growing, and of the methods of production and utilization that will be most efficient. On such knowledge public policies of forestry can be securely based and the extension of private forestry soundly guided.

FOREST EXPERIMENT STATIONS

In continuance of the policy which aims to build up throughout the country a series of forest experiment stations, one for each of the major forest regions, two new experiment stations were provided for by Congress last year. One of these, the Allegheny, will serve the needs of the Middle Atlantic States exclusive of New York, which is served by the already established northeastern station. The other will have for its field the predominantly agricultural region from Ohio westward to Iowa and Mis-

souri, with part of Kentucky and Tennessee. Farm forestry, the place of the wood lot in farm economy, and the best use of marginal and submarginal agricultural lands in the region will mainly occupy the attention of this station.

Including these additions, the regional forest experiment stations now provided for are the Northeastern, the Allegheny, the Appalachian, the Southern, the Central States, the Lake States, the Northern Rocky Mountain, the Pacific Northwest, and California. The central Rocky Mountain region and the Southwest remains to be equipped for forest research on a basis comparable to that of the other principal regions.

While rapid progress has been made in establishing the series of forest experiment stations the development of the individual stations has by no means kept pace with the growing demand for technical information upon which to build sound timber-growing policies and practices. One outstanding requirement is for the expansion of the work in the Pacific Northwest to include Alaska. The establishment of large pulp and paper enterprises in Alaska will necessitate information as to the best methods of cutting to insure quick regeneration, the time necessary to grow a new forest crop, and the area necessary to insure a continuous supply of raw material for plants of a given size. In California also a considerable expansion of the work is needed to cover adequately the major forest subdivisions. The rapid growth of the State is placing a heavy demand upon its forests, and if California is to supply her own wood requirements intensive forest management must be developed. There are now over 10,000,000 acres of virtually idle brush lands, most of which might be growing a valuable forest crop.

Investigations in the Lake States have been concentrated on a few large problems, such as increasing the forest growth of swamps by drainage and applying selective logging in the northern hardwoods so as to permit the remaining forest to be handled on a perpetual basis. In this region however, a vast extent of former pineland is now denuded of pine, burned and reproducing with aspen, birch and scrub oak. These lands are comparatively close to large consuming centers. How to reclaim them and convert their scrub growth into valuable forest is an outstanding economic problem, upon which in-

mediate silvicultural work is necessary.

Each region has its own group of problems peculiar to its own local forest types, climate, and soils. Studies under way include those to determine the best methods of harvesting old timber in order to reproduce a crop of desirable tree species in the shortest possible time, to determine the actual rate of growth and the yield of wood produced at various ages, to demonstrate methods of forest planting for denuded land that will establish the most desirable species at the lowest possible cost and with the highest degree of success, and to determine how best to protect forests from fire. In the South studies of the protection of naval stores assume primary importance, and accordingly methods of turpentine are being sought which will give the highest yields with the least injury to the forest. In the Northeast, where pulpwood production is a primary consideration, methods of management which will produce the largest yields of pulp wood are being studied. In California, studies of stream flow and erosion are being made to learn how best to improve the vegetative cover for the protection of water courses and prevention of erosion.

The results of investigations carried out at the forest experiment stations are already proving of value. Much progress in the study of forest-fire weather has been made at the Northern Rocky Mountain Forest Experiment Station. The study has reached a point where rules have been formulated and made available for use in the measurement of weather changes which indicate fire danger. Close cooperation from the Weather Bureau in this work has resulted in the installation of a regular fire-weather warning service. Warnings are of great value to fire organizations on national forests and on private holdings in order that adequate preparations may be made for an emergency.

The natural replacement of blight-killed chestnut has been under investigation for some time. The main purpose of this study is to find out just what has happened to the big gaps in our eastern hardwood forests caused by the death of the chestnut. Results of the study thus far obtained, as set forth in Miscellaneous Circular 100, show much room for optimism. The gaps are gradually filling in by natural seeding with many different hardwoods, chiefly oaks, so that it is hardly necessary to adopt a planting program

to bring these areas back into a productive condition.

A study of the yield of spruce in the Northeast is indicating the amount of wood suitable for the production of paper which may be expected from various classes of forest land. Information has been obtained as to the right time in the life of a crop of timber to cut and still maintain a full stocking of reproduction. Along with this, determinations of the rate of growth have been made which will enable the operator to plan on when he can return for a second cut after the first crop has been harvested.

Investigations of nursery practice in the northern Rocky Mountain region have disclosed a simple yet very effective method of controlling weeds through the use of chemicals. The results of this work are applicable not only in forest nurseries, where weed control is expensive, but as a means of reducing fire hazard in lumber yards, oil plants, around factory buildings, along railroad tracks, and in other places where inflammable material is a source of danger.

A planting survey in the Lake States is nearing completion. Up to and including 1926, 73,000 acres had been planted, while 20,000,000 acres are in need of reforestation by this method. Study of old plantations has developed important facts regarding methods of planting, species, and classes of stock to use on different sites and in different localities.

Studies in slash disposal are being carried on simultaneously in the western yellow-pine type of the Southwest and the Pacific Northwest. Débris resulting from logging represents a very serious fire hazard. Complete disposal of slash by broadcast burning destroys most of the young growth left on the ground. Improved methods of disposal are being developed whereby the hazard may be reduced and as much as possible of the young growth preserved.

FOREST ECONOMICS

The forest-taxation inquiry continued its investigation in Minnesota, has well under way a study in Wisconsin in cooperation with the University of Wisconsin, and did some preliminary work in Michigan. Principal attention was given to Minnesota. Intensive field studies gathered all facts bearing upon the tax situation in general and the taxation of forests in particular, in 21 townships selected from four counties in the northern part of the State and one county in

the southern part. This material was brought into relation with more general information relating to the rest of the State. Simultaneously a thorough study was made of all the special forest tax laws which States have enacted.

One thing which has become clear is that forest taxation is not a separate problem, to be isolated and studied apart from the taxation of other kinds of property. The inquiry finds itself of necessity engaged in a comprehensive study of the whole system of American State and local finance, with the forests in the center of the picture.

The plan of the inquiry is to study intensively certain key States or regions. This does not imply a series of disconnected studies, with separate conclusions and recommendations. On the contrary, the forest-tax problem of the entire Nation is regarded as the unit. While certain regions are selected for intensive study, general principles based on all the facts obtained, and on facts obtained in all parts of the country, are being sought. The announcement of conclusions is unlikely before the whole study is completed. The investigation appears likely to continue for five or six years. Early suggestions as to the best methods of forest taxation would be premature, since they would be in advance of the evidence. This, however, does not preclude placing information which has been gathered in the hands of those to whom it may be especially useful, as indeed was done in the past year. Partly with this in mind, field work will be begun in the Pacific Northwest in 1928. Here the problem is of high importance and local interests are anxious to cooperate in its solution.

The economic factors affecting the ownership of forest land in a portion of northern Wisconsin, the return obtainable from it, and its relationship to local communities was made the subject of a separate study, undertaken to learn how these factors may influence forest policies for the region.

The collection of stumpage, log, and lumber prices continued, and an analysis of the price records as a partial index of the economic practicability of timber growing was nearly completed for publication. Cooperation continued with the Bureau of the Census in gathering information on the production of lumber, lath, and shingles.

Data were obtained for studying the distribution of the hardwood and softwood lumber produced in each State. Statistics on wood preserved and pre-

servatives consumed in 1926 were obtained and tabulated as usual.

Cooperation was undertaken with the Chamber of Commerce of the United States in preparing for a forestry conference, at which the results of a survey of the progress of forestry in the United States will be presented. The conference will deal with the commercial possibilities of forestry and measures necessary to lessen the obstacles to private forest management. A proposed study of forestry in relation to submarginal agricultural land in cooperation with the Bureau of Agricultural Economics, has in view through surveys of selected States to determine the basic facts and principles for a sound economic classification of land included in farms but suitable for timber growing. Means are available to undertake this project only in a very small way.

There is also great need for a comprehensive and detailed forest survey of the entire country which would bring out all facts regarding timber supplies, imports, substitutes for wood, and growth of timber on one hand, and on the other present requirements, rate of cutting, other drains upon the forests, and wood exports. This is the most important and fundamental of all economic studies but involves an enormous task.

These projects are suggestive of far-reaching scope and practical importance of the field of forest economics research. To place forestry on a sound basis the economic forces at work must be understood.

FOREST-PRODUCTS INVESTIGATION

Forestry will be practiced to the extent that owners of forest land have confidence that wood will hold a leading place among industrial materials and that forests will increase in value. The developments of the past year have shown with increasing clearness that research in forest products is not only a means of reducing timber waste and extending the economic service of wood but also one of the most important ways to make forestry pay.

FIELDS OF FOREST-PRODUCTS RESEARCH

The determination of wood properties and their control through methods of selection, manufacturing processes, or subsequent special treatments is a field of research which includes some of the problems most vital to successful timber utilization. There are about 150 important nat-

oods, each possessing over 30 properties of commercial significance such as hardness, shrinkage, resistance to decay, and heat insulation. Each of the 150 species exhibits considerable variation in its 30 or more properties, not only for the species as a whole but in each locality where it occurs. Intelligently employed, this variability of wood becomes an asset by extending the uses to which it can be satisfactorily adapted. Disregarded, it becomes a liability. Both producer and consumer need to know the range of a given property that may be expected in a commercial species of wood from a certain producing locality. This knowledge is at present available only in a limited way in the case of most of the 30 properties. The opportunity for control of wood properties begins in the forest. To grow more wood is not enough. The problem is to grow high-density wood, low-density wood, straight-grained wood, decay-resistant wood, etc. It is a matter for research, and to solve it the forester, the physicist, and the chemist must all work together.

Other fields of forest products research include a determination of use requirements and the design of wood products. For the hundreds of uses of wood there are few specifications based on technical facts and material chosen under a wide range of opinion and prejudice. Only for a few structural uses is wood selected by properties such as density, location, and size of knots, and straightness of grain, so as to insure satisfaction for the use intended. The design of wood products presents great opportunities for research to bring about economy of usage.

Three other broad fields under which research in forest products may be grouped are the development of necessary materials for use with wood, such as glues, preservatives, paints, and fastenings; the development of more economical production processes through all stages of manufacture, distribution, and storage; and the conversion of forest materials into chemical and fibrous products, such as pulp and paper, turpentine and rosin, and liquors.

MOST URGENT PROJECTS

These fields of research have been mapped out by the Forest Products Laboratory and summed up in an "enlarged program of 110 research projects." From this program the most urgent projects have been selected for

inclusion in an expanded laboratory program. These projects bear upon immediate problems, largely those whose solution is demanded by consuming or manufacturing interests or which have a direct bearing upon the more complete and effective utilization of forest crops.

Certain of the selected projects deal with the grading of lumber for density, the correlation of mechanical, chemical, and physical properties of wood, and lumber storage and handling practice, all fields in which considerable work has already been done. On other urgent projects, such as the heat-insulating value of wood, the development of fire-resistant wooden construction, and the decay hazards in typical wooden houses, practically nothing has been done although related studies previously conducted have given the Forest Products Laboratory a good background to start from.

PROGRESS DURING THE YEAR

A major research project undertaken this year has for its object the definition in American lumber standards of (1) the degree of dryness of lumber at which the standard sizes shall apply and (2) what constitutes seasoned and unseasoned lumber in different commercial uses. Field tests proved that the proposed plan of basing standard sizes on the weight of the lumber at time of shipment was unreliable, because of the great variation in the weight of the dry wood. They also showed the actual variation in moisture content of lumber shipped from different regions as kiln dry, air dry, etc. In the case of certain pine mills, kiln-dry lumber as shipped had a moisture content averaging 9 per cent, and 80 per cent of such stock had a moisture content between 4 and 14 per cent. When similar data are obtained for other conditions and regions and when work now under way on the moisture content that woods attain under service conditions is completed the basis for trade agreement will have been provided.

The laboratory at Madison, Wis., has been working on the possibility of expressing lumber seasoning and size definitions either in terms of permissible shrinking and swelling or in terms of actual moisture content. Since either method depends upon rapid, practical means of making measurements, considerable research has been devoted to these ends. Several devices have been developed by

the laboratory for quickly determining the moisture content of wood. None of the methods is yet ready for commercial use, but with the additional refinements and tests planned the laboratory is hopeful of soon providing the industry with these much-needed tools.

In furtherance of American lumber standards the laboratory worked out a system of basic grades for hardwoods, which would (1) reduce by half the waste at mills in remanufacturing to raise grades, (2) bring together in the same grade boards of similar cutting value for the fuller use of lumber at fabricating factories, and (3) simplify the grading system to the particular benefit of small saw-mill operators so that logs can be sawed to realize their highest grades. The necessary mill try outs were made to compare this system with others proposed. The outcome was that the hardwood trade, divided for years on the question of proper grades, has made unanimous recommendations to the central committee on lumber standards. While a different system of basic grades was recommended from that worked out at the Forest Products Laboratory, the action taken was a long step toward acceptance of the principles advocated by the Forest Service.

Logging and milling studies by the laboratory are proceeding region by region to determine the margin between costs and returns from forest by-products, consisting of small and top logs and mill edgings and trimmings. If the utilization of such items can be shown to yield even a small profit, forestry practice, particularly on private holdings, will be facilitated. Studies are well under way toward an evaluation of the losses that occur so commonly in small mill operations in the short-leaf pine region, and may be expected to increase the efficiency of such plants in that region. In the northern hardwoods work thus far indicates that trees smaller than 12 to 14 inches in diameter are frequently cut at a loss, which could be turned to a profit if the trees were left for a later cut. Under selective logging in northern hardwoods the indications are that the highest return per thousand feet is obtained under cutting to a diameter limit of approximately 18 inches.

A survey of woods waste in 11 logging camps of the Douglas fir region in the Pacific Northwest yielded very interesting results. The smallest amount of material found on a single

acre of logged-off land was 6,916 board feet and the largest amount on an acre 52,235 board feet. The average amount of woods waste per acre if the company leaving the least material on the ground was 10,450 board feet, or 11.1 per cent of the original stand; and for the company leaving the most material, 33,107 board feet or 37.7 per cent, of the original stand. The average amount of woods waste per acre for the 11 companies was 20,599 board feet, or 20.7 per cent of the original stand. The material left in the woods was classified into three grades of saw logs, cordwood, pulpwood, shingle bolts, poles, and pilings together with waste in high stump trees left standing which will be destroyed, and sound material in standing snags. The information on woods waste derived from this survey gives some idea of the immense field for research in developing methods of utilizing what is at present largely unavoidable waste.

Within the last year attention has been given to the treatment of lumber suitable for the home builder's use and to arrangements for marketing through retail lumber dealers. This, but the beginning of a movement which promises to develop a new field for treated wood and to bring important benefits to the consumer as well as to those who manufacture and sell the treated lumber. Up to the present the wood-preserving industry has confined its attention almost entirely to the treatment of wood in large quantities, chiefly for the use of railroad ties and other large consumers. It has been practically impossible for anyone to purchase a small quantity of lumber thoroughly impregnated with a preservative against decay and insects, both of which are of great economic importance and destroy large quantities of lumber annually.

Tests of the mechanical properties of Alaskan woods showed these woods to be equal in strength to the same species grown elsewhere. A bulletin is to be prepared on Alaskan woods to aid in their utilization.

In the study of second-growth southern pines it has become apparent that the weight or density of the wood of young trees can be controlled by regulating the crown development. This study has demonstrated that it is possible to produce just as dense southern pine timber in second-growth stands as is found in the virgin forests. When the proper silvicultural methods have been worked out, it will be possible for the forester to determine

advance the type of wood best suited to the soil or a given site and produce wood predominantly of this type.

Experiments were begun in the lifting of highly figured black walnut stock on ordinary black walnut seedlings to ascertain whether trees of highly figured wood may be produced in this way. The production of trees containing a high proportion of figured wood would greatly increase the value of future walnut growth in farm and orchard lots.

Shipping containers continue to require a large part of the annual cut of timber and afford an excellent medium through which to effect economies in utilization. Studies of the wire-bound type of box have resulted in the development of a box-designer's chart, whose use commercially will in many cases save material or reduce damage in wire-bound boxes. Preliminary experiments point to the possibility of substituting low-grade regraded lumber for the clear quality air-dried veneer now commonly used in the wire-bound box.

Studies carried out in cooperation with the Bureau of Aeronautics of the War Department have yielded valuable data for use in aircraft design, the bearing strength of wood under bolt loads, and the lateral buckling of twisting of deep beams. A manual was prepared for inspectors of airplane lumber and wooden airplane parts presenting the special instructions required for properly judging the properties of wood and for selecting stock suitable for airplane manufacture. A bulletin for the general public on the identification of woods used in furniture was prepared and published.

On further applications of collodion unique to the structure of wood, a rapid and accurate method has been developed for determining the minimum, average, and maximum lengths of the fibers of different species of wood. It has also been possible to determine the average and maximum diameters of the openings between the cells of wood. The average is about one-tenth of the smallest openings which can be seen with the best-powered microscope, while the maximum is very close to the smallest which can be seen microscopically. This information should be of value in connection with the impregnation of wood with liquids. The lignin in wood, which was previously shown to occupy both the middle lamella and cell wall, has been more accu-

ately divided and about 50 per cent is found to exist in each place. The lignins as thus separated were shown to be slightly different chemically.

Improved methods of operation and control of the sulphite pulping process as developed by the laboratory have been important factors in making possible the use of that process on hardwoods. Hardwoods have heretofore been pulped almost exclusively by the soda process. Laboratory and mill tests have shown that higher yields and better qualities of pulp, at least for some purposes, can be obtained by the sulphite process.

Two plants were installed and placed in operation during the year to produce pulp by the laboratory's newly developed semichemical process. One plant is converting gumwood into light-colored wrappings and the other is converting waste coniferous wood into pulp for use in container board. The rod mill, first applied to the pulp and paper industry by the laboratory, is an essential factor in the success of the semichemical process. It is proving of value also in refining screenings from chemical pulp mills and in beating chemical pulps. Numerous commercial installations during the year have demonstrated the practical value of the mill for those purposes.

Noteworthy advances have been made in the method of measuring the color of bleached pulps and in the interpretation of data thus obtained. The published results of this study have been very favorably received by the industry.

The work of the National Committee on Wood Utilization, under the leadership of the Department of Commerce, has been helpful in aiding to bring into commercial practice the findings of the Forest Products Laboratory that make for the more effective utilization of wood.

RANGE RESEARCH

A scientific basis for grazing timber and range land is essential. It is especially urgent where watershed conditions are easily altered. Grazing could not be eliminated from these watersheds without practical ruin to the western range livestock industry. The 36,000,000 cattle, horses, mules, sheep, goats, and swine in the 11 far Western States obtain nearly 70 per cent of their yearly feed from range land, largely the source of irrigation waters and municipal water supplies.

The watershed problem is especially critical in the Southwest, where the

vegetation at best is sparse, where drought may cause this meager vegetative cover to be reduced by a half or more in one year, and where overgrazing may cause extreme range depletion as well as an enormous amount of erosion. The 12 years' intensive study of the relation of herbaceous vegetation to surface run-off and erosion on high mountain watersheds at the Great Basin Experiment Station in Utah has shown the importance of maintaining as dense a vegetative cover as possible. Properly controlled grazing not only will not injure such watersheds when the vegetation is in good condition but may aid in their further improvement.

The half million acres or more of timberland in the Southwest on which satisfactory timber regeneration has been prevented or retarded by improper grazing call for research to determine specifically how timber and grazing use may be best combined and adjusted to each other. The forage conditions on the ranges of the Southwest in themselves demand attention. Drought and overstocking have seriously depleted much of the forage growth. Research on the semidesert yearlong cattle ranges at the Santa Rita Range Reserve in southern Arizona has developed improved range and livestock methods, enabling a sustained production of forage and livestock and a net profit of approximately 7.4 per cent through the recent trying years. Research can be of similar aid in improving grazing practices for all types of range.

Range research is responsible for the development of the deferred and rotation system of grazing; for open herding and the bedding out ("blanket") system of handling sheep; for improved practices with respect to salting, range water development and distribution, grazing periods, range utilization, and determination of the seasonal readiness of range plants for grazing; for methods of eradicating larkspur and other poisonous range plants; and for palatability studies of range plants which have furnished a sounder basis for determining carrying capacity and overgrazing. All of these improved practices are materially enhancing the productivity of national forest ranges and have increased the financial returns to the livestock industry greatly in excess of the money expended for research.

The work of the year in range search included completion of a manuscript covering the essential features of proper utilization of the important western browse plants. Studies of western range herbaceous plants and of regionally important range plants having the same end in view, are being continued. The results of a 15 years' study of artificial reseeding of high mountain range lands were prepared for publication. While the cost of seeding most cultivated forage plants on the range is ordinarily justified, Kentucky and Canada blue grasses, smooth brome, timothy, and orchard grass give some promise on depleted range areas where soil and moisture conditions are unusually favorable. Several native forage plants, especially violet wheatgrass and mountain brome, have given excellent results in artificial reseeding, but lack of an adequate supply of seed precludes their extensive use now.

A manuscript was prepared covering a study of range utilization in relation to maintained forage production and the production and marketing of livestock. Better utilization practices would assure greater unit production, better development of animals and increased profits. Study of utilization of mountain brush lands in Utah as summer range for cattle showed that brush areas can not probably be stocked on the basis of reasonably full use of the oak, but that their use must be based upon proper grazing of the more palatable plants.

Analysis of the 10-year record of cost of producing cattle on the Jorner Range Reserve in southern New Mexico showed that conservation of range and conservative stocking stand out as the prime factors in profitable cattle production in the region. Good range conditions are reflected in the condition of cattle, high calf crop and low losses, considering the exceptional drought conditions which prevailed during most of the period.

During the coming year the aim will be to bring about a greater correlation between range research and other forest research, to complete the analysis for publication of a number of important studies which have been under way for several years, and intensify those investigations which offer greatest possibilities for improving range conditions and increasing profits and stability for the livestock industry.

REPORT OF THE FORESTER

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., September 1, 1928.

SIR: I have the honor to transmit herewith the report of the Forest Service for the fiscal year ended June 30, 1928.

Respectfully,

ROBERT Y. STUART,
Forester.

Hon. W. M. JARDINE,
Secretary of Agriculture.

FOREWORD

Most of the fiscal year covered by this report falls within the term of office of my predecessor, William B. Greeley, whose resignation took effect May 1. He was in charge of the Forest Service for eight years and a member of it continuously, except for military service during the World War, from 1904. At a material personal sacrifice he gave the forestry movement throughout the country leadership of an outstanding character, and the gains made during the year were largely a fruition of that leadership.

THE TWO PRIMARY TASKS OF THE FOREST SERVICE

The work of the Forest Service divides into two primary tasks—national forest administration, and promotion of the best use of all forests and forest products throughout the United States. In eventual importance to the public welfare the second named ranks first; for the national forests contain less than one-fifth of the forest land in the country, and their capacity to grow timber is scarcely more than one-tenth of what all our forest land might produce under skillful management. In expenditures, however, the national forest work has the lion's share. Details regarding the character and purpose of these expenditures will be found on page 59. The expenditures for all purposes totaled \$22,657,454.83, of which those designed to further State and private forestry and to promote the best use of all

forests and forest products throughout the United States made up \$2,166,706.65.

OUTSTANDING FEDERAL LEGISLATION OF THE YEAR

From the standpoint of the national interest in more and better forestry, a notable development took place last year. This was the passage by Congress of two measures which may fairly be hailed as, together, of epoch-making importance—the so-called McSweeney-McNary law, laying down, through specific authorizations for a 10-year period, a financial program for the expansion of forest research, and the so-called McNary-Woodruff law, laying down a similar program for enlarged purchases of land for national-forest purposes during the fiscal years 1929-1931, inclusive. The relationship of the second law to the general forestry situation will be shown a little later. It is true that these acts become effective only to the extent that Congress actually makes the appropriations which they merely authorize; but both measures were reported upon by the Bureau of the Budget as not inconsistent with the financial policy of the administration, and their enactment gives a considerable assurance that their essential purposes will be attained. These laws will unquestionably accelerate the forestry movement throughout the country.

BETTER KNOWLEDGE ESSENTIAL

The ultimate goal of the forestry movement is the best use of all forest lands in the United States. As long

ago as the early seventies of the last century there was widespread uneasiness over the rapid rate of forest destruction. To this period belong the Federal timber culture act, a considerable number of State laws designed to encourage forest planting through bounties, tax exemptions, and like measures, a certain amount of equally futile forest-fire legislation, efforts of railroad companies and others to introduce extensive timber growing in the prairie and plains region, and so on. In 1877 the Secretary of the Interior urged that the policy of disposal of the public domain timberlands should be replaced by a policy of retention of the land, sale of mature timber at its market value, the reservation and protection of young growth, and provision for securing reforestation of cut-over areas—in other words, virtually the present national-forest policy applied to a much greater forest area. Even so we would not now be on a par with Canada, which has and will retain in public ownership over 90 per cent of its forests; but we would be much nearer that position. The proposal, however, was premature. The law would not have stood, had it been passed. The fundamental need was for more knowledge—better knowledge as to what a sound public policy really made requisite, knowledge as to how to make it work successfully, and public understanding of the issues involved.

In 1873 a committee created by the American Association for the Advancement of Science addressed a memorial to Congress asking for the creation of a Federal "commission of forestry," the duties of which would be to ascertain (1) the amount and distribution of woodlands in the United States, the rate of consumption and waste, and the measures requisite to assure adequate future timber; (2) the influence of forests upon climatic conditions, especially those necessary for successful agriculture; (3) the methods of forestry as developed and practiced in Europe. Eventually Congress made a partial response to these recommendations by appropriating, in 1876, \$2,000 for the employment by the Commissioner of Agriculture of "some man of proved attainments" to "prosecute investigations and inquiries" along the lines proposed. The published reports of the old Division of Forestry show how decade after decade, with the most meager provision of resources for the purpose, the economic facts basic for the determination of sound public policies were striven for.

Nevertheless, many false suppositions remained long current. Even now we do not fully know "the true condition and wants of the country" still less do we know in full the measures requisite to assure adequate future timber supplies. It was in recognition of this fact that Congress enacted last May the McSweeney McNary Law—the first entirely comprehensive provision for forest research ever made in this country. The work for which \$2,000 was appropriated in 1876 and which has been going on ever since, at first as a one-man job, and with expenditures to the very end of the nineteenth century never as much as \$30,000 annually, now receives a Federal authorization up to a maximum of \$3,375,000 annually within the next 10 years, a further authorization of \$3,000,000 available at the rate of \$250,000 a year, and beyond 1938 such annual appropriation as may thereafter be necessary to carry out the law.

WHERE WE NOW STAND

The forest problem concerns the most economical and advantageous use of one-fourth of the land surface of the continental United States—to say nothing of Alaska, our insular possessions, or our interest in the possible contributions to American requirements of the tropical forests south of us. It concerns the best use of this huge land surface not only for the production of wood—important as that is to our economic well-being—but also for meeting other and varied public needs. Especially does it concern the regimen of water flow from our natural forest regions.

It concerns also the auxiliary use of a large part of this vast land area for livestock production; its relationship with agriculture, mining, and other land uses; its production of game, fish, fur bearers, and other forms of wild life; and its public value for recreational purposes. The difference between right use of it and in the best interest of the general welfare and unintelligent use is crucial. A great national interest is involved.

THE EASTERN PROBLEM

In some quarters the impression is gaining ground that our forest problem has in the main been solved, and will work itself out. A great further public effort must be made. In chief part it must be made in the East. In very large part it must be made by the States and local communities in the

East. The eastern half of the so-called continental United States—that is, exclusive of Alaska—contains three-fourths of the forest land, six-sevenths of the population, and five-sixths of the land in harvested crops; but less than two-fifths of the standing saw timber.

Less than one-sixth of its forests are virgin, and it is now drawing upon the virgin stands of the West for more than one-fifth of its annual consumption of lumber. Cut-over forests, varying in present condition from second growth ripe for the saw to land wholly denuded of valuable timber and incapable of again producing valuable timber without expensive regenerating measures or an indefinitely long delay, make up all but a relatively small and fast-diminishing portion of the eastern total forest area; and of the total more than nineteen-twentieths is privately owned. That, in a nutshell, indicates where lies the country's main forest problem of today. What is to be the future of this enormous private forest land area east of the great Central Plains?

The West is an entirely different situation. Of its forest land, three-fourths is in public ownership, and the future of this land is virtually assured. It will nearly all remain publicly owned and continuously productive. The Federal Government alone owns more than 70 per cent of the forest land in the West, while States and municipalities own 3 per cent. In the East, on the other hand, the Federal Government owns less than 2 per cent and States and municipalities less than 3 per cent. The West, therefore, is in a position much more nearly approximating that of Canada, where, as already noted, over 90 per cent of the forest land is publicly owned, while the East is in a position without parallel in any civilized country of at all comparable conditions.

The British Isles, it is true, show an even higher percentage of private forest land ownership than the eastern United States; but less than 5 per cent of Great Britain and Ireland is in forest. The United Kingdom has in consequence become almost entirely dependent upon other countries for its requirements of lumber, mine props, pulp and paper, and other forest products, while at the same time it fails to utilize fully the capacity of its land to grow needed timber crops and to give labor employment. Incidentally, since the war afforestation has been recognized in Great Britain as of large importance to the nation.

The United States can not afford to let things drift, to wait passively for economic forces to work out the problem in their slow way. In time those forces alone would largely accomplish what needs to be done. Gradually private landowners will come to grow timber crops on a larger and larger part of the 336,000,000 acres of eastern forest land which they now own. Gradually they will abandon a larger and larger part of the land which they can not make pay enough to meet its tax bills; and gradually forced public ownership of these abandoned and wrecked lands, brought about through a process of automatic land classification, will lead to policies of public administration and reclamation expenditures. Gradually the public and private burdens imposed by maluse, both in the form of shortages of necessary forest products and in the form of impoverished localities, stripped mountains, man-made deserts, and violent changes in the character of stream flow, will sternly bring home the necessity for finding remedies. But the cost of waiting for all this and the easily preventable deterioration in the ability of the forest to respond to right practices make the suggestion of such a course monstrous.

Already conditions have been created in parts of the country which leave it doubtful whether some of the land has not passed over from the class of potentially useful into the class of permanent though artificial desert. It may be past the point at which it will even repay public reclamation. To let this conversion go on is a crime against posterity. It is also an impairment of present values such as we can not ourselves afford.

THE FOREST LAND PROBLEM IN THE WEST

A situation which has arisen in Idaho during the year illustrates the danger. The Idaho law requires all forest-land owners to maintain adequate protection against fire. If they fail to do so the State supplies it and charges the cost to the owners as a tax. The timberland owners have organized protective associations, with which the State cooperates. These associations maintain protective systems, each covering a certain territory. In proportion to its own forest-land holdings within the territory, the State contributes toward maintaining the system; and it constitutes the associations its agency for protecting lands whose owners do not voluntarily take on the task.

Climatic conditions make the cost of protection high. In north Idaho the associations contract with some small owners to provide protection on the basis of 6 cents per acre per year, and at that do not nearly reimburse themselves. For the sake of their own timber holdings, however, they must cover all the land.

This system is threatened with disintegration. As company holdings are progressively cut over the inducement to pay the cost of protection grows less and less, for the interest of most owners is chiefly if not wholly in the merchantable stand. The alternative to paying the cost of protection on cut-over lands is tax delinquency; and that is rapidly developing.

As already noted, the protective associations can not limit themselves to selected lands. Fires show no respect for section or township boundaries. Consequently lands on which taxes are uncollectible can ride free. When they do, they increase the bills for those who still pay.

Unappropriated and unreserved lands of the United States have been riding nearly free. Tax-reverting lands ride free because they pass not to the State, which cooperates with the associations, but to the counties, which do not cooperate and do not see how they can afford to cooperate. Consequently the lands which should be a permanent asset to the counties through continuous timber production are being converted into a permanent liability through loss of the young growth left after logging. Most of the land, especially in north Idaho, is not worth its carrying cost for grazing use alone; and aside from timber growing and grazing it has no use, either present or prospective.

This has resulted in a strong local demand for a law to extend materially the St. Joe and Coeur d'Alene National Forests. The object sought is twofold: To obtain adequate protection of the widely scattered areas of unreserved public lands that would be thrown into the forest through establishing new boundaries, and to make possible the acquisition by the Government of private cut-over lands under the provisions of the general exchange law.

The underlying economic factors involved are clear, and they will be operative ultimately far and wide throughout the West, as they are already operative in certain parts of the Lake States and in other regions of the East. Private ownership of extensive areas of western timber-

lands has been undertaken in order to obtain the timber. That gone, much of the land will come back on the public. Originally a part of the public domain, through tax reversion it is forced out on the State or county. To restore it to productive condition is a long and burdensome undertaking, which neither the States nor the counties as a rule want to assume. The public welfare requires that it be assumed, and in many cases national-forest administration affords a means for accomplishing it. Under these circumstances the local anxiety that has sometimes been manifested for having the valuable national-forest timberlands opened to private acquisition or made over to the State is replaced by a pronounced anxiety to have the forests made larger.

The Idaho example suggests important questions of future public policy in handling national-forest land and timber exchanges, and of relations with the Western States. They are to some extent outlined in the section of this report entitled "The national forest properties." They suggest also that the Western States have some large problems of their own in connection with the permanent use of their forest lands which will have to be worked out in other ways than through the national forests alone as important as is their part.

PROGRESS IN PUBLIC FOREST OWNERSHIP

Land purchases by the Federal Government for forest purposes began in 1911, when the Weeks law provided for the purchase of lands necessary to regulate the flow of navigable streams. The Clarke-McNary law, passed in 1924, formulated a larger Federal policy of forest-land acquisition. It authorized and directed the Secretary of Agriculture to recommend for purchase also such lands as in his judgment are necessary for the production of timber. All recommendations of purchase for either purpose are made to the National Forest Reservation Commission, as the approving authority. The McNary-Woodruff law, passed last April, supplements the earlier laws by setting up a definite program of expenditures for both purposes together. For the fiscal year 1929, \$2,000,000 was authorized; for 1930, \$3,000,000; and for 1931, \$5,000,000.

As originally framed the McNary-Woodruff law had in view an authorization of appropriations to a total of \$40,000,000, over an 8-year period.

beginning with 1928. This program, however, was found by the Bureau of the Budget not to be in accord with the financial policy of the administration. The program was therefore curtailed to that already indicated. The agricultural appropriation act carried a \$1,000,000 acquisition item for the fiscal year 1929, and the second deficiency act added \$1,000,000 more, which, however, was pledged beforehand for expenditure to acquire the so-called Waterville tract in the White Mountains of New Hampshire—a special case of which more will be said later. The main thing to be noted in connection with the McNary-Woodruff law is that it authorizes the undertaking in the fiscal years 1930 and 1931, if Congress makes the necessary appropriations, of a purchase program markedly larger than that of the past.

The enlarged program had its origin in the inquiry into the forest situation throughout the country made in 1923 by the Senate Select Committee on Reforestation. The hearings held by that committee in the various forest regions of the United States disclosed that vast areas of forest land were in danger of lapsing into unproductiveness, that where new timber growth has followed utilization of the original stand it is in large part a relatively poor growth—a wild-land natural crop produced in the face of many adverse circumstances of man's making—and that the future timber needs of the country are not being adequately provided for. The Weeks law program had taken no account of the needs for reforestation of more than a very small part of the forest lands of the eastern United States and was entirely inadequate to meet public requirements even for stream-flow protection.

The 1927 Mississippi floods brought forcibly home the inadequacy. Not that forests alone could have controlled those floods; their function is auxiliary. Following the 1927 disaster the Forest Service undertook a comprehensive survey of forest conditions over the entire Mississippi Basin as related to flood prevention. The results were presented to the Committee on Flood Control of the House of Representatives in a special report, which has since been published under the title "The Protection Forests of the Mississippi Valley Watershed and Their Part in Flood Prevention." The report made clear at the outset that forestry should not be thought of as an alternative to artificial works of control; but it showed that the need

for forestry to supplement such works is both real and extensive.

Very briefly, the study brought out that of the more than 1,230,000 square miles in the Mississippi Basin 289,000 square miles, in round numbers, are embraced in what may be termed "critical areas"—that is, areas on which the vegetative cover exercises such an influence on the character of the run-off or on soil erosion as to be important from the standpoint of flood control. These critical areas embrace about 150,000 square miles of forest land out of a total of about 244,000 square miles of forest land in the entire basin. While forest land now constitutes only one-fifth of the entire area of the basin and never constituted more than about two-fifths, the consequence of serious impairment of the capacity of the forest to retard run-off and prevent erosion on the critical areas makes necessary public action both to conserve forest values on portions of these areas where the present conditions are beneficial and to restore forest values where the present conditions are detrimental or neutral.

About 35,000 square miles of forest land in the basin has been so denuded of valuable forest or other growth as to fall into the class of "idle" or "waste" land. Farm woodlands comprise about 115,000 square miles, or 47 per cent, of the entire forest-land area and include about 10,000 square miles of "idle" or "waste" land. State and Federal forests and parks contain, respectively, 700 and 43,000 square miles, or 18 per cent of the forest land. The only forest lands on critical areas that are now contributing full service from the standpoint of flood control are those embraced in public forests and parks; and a substantial increase of public forest-land ownership and administration will be essential to the adequate regulation of stream flow on the headwaters of the Mississippi and its principal tributaries.

The same is true elsewhere. Altogether there are unquestionably scores of millions of acres in the East that are subject to harmful erosion and seriously accelerated stream flow discharge through impairment of the forest cover, and to a degree which will presumably necessitate much more extensive public-forest ownership than even the present national program contemplates.

That is not a task for the Federal Government solely. To a large extent

it should be a State function. Often local public welfare is chiefly involved; nearly always it is largely involved. Some of the Eastern States are assuming substantial responsibilities for the maintenance of forest conditions through land acquisition. New York's "forest preserve" includes more than 2,000,000 acres of State-owned land in the Adirondack and Catskill regions; Pennsylvania has under management nearly 1,300,000 acres of her forest-covered mountain ranges; and both States are adding to their holdings. Protection forests—which may also be made heavily timber producing, as Pennsylvania is making hers; which if carefully bought and skillfully managed should commonly prove a source of net revenue; and which always can be made to render other important public services as recreational areas, protectors of scenic values, and producers of game and other wild life—should receive the consideration of almost every State east of the plains.

What is called for immediately is a more intensive study than has hitherto been made of the extent and character of the need in this field. The survey of forest conditions throughout the country necessary as a part of the still more general survey contemplated by section 9 of the McSweeney-McNary law will, if the authorization therein conveyed is made effective through appropriations to finance the work, afford essential data for working out a comprehensive policy, with due correlation of Federal and local responsibilities in a unified plan of action. Meanwhile the act of May 15, 1928, "for the control of floods on the Mississippi River and its tributaries," has directed that the President shall "proceed to ascertain through the Secretary of Agriculture and such other agencies as he may deem proper the extent to and the measure in which the floods in the Mississippi Valley may be controlled by proper forestry practice," and on June 1, the President requested the Secretary of Agriculture to ascertain and report to him regarding this matter. Accordingly such additional studies of the relationship between proper forestry practice and flood control will be made as are possible with the present appropriations.

THE STIMULATION OF PRIVATE FORESTRY

One of the most significant developments of the past few years, as pre-

vious reports have brought out, has been a changing attitude of large timberland owners and of the lumber and other forest-using industries toward forestry. Timber growing is no longer regarded as something outside the range of business consideration. Instead there is a widespread open mindedness and a general acceptance of the fact that it will have to be undertaken. But private land management for this purpose must at best come gradually. It calls for skill in applying the right woods practices for going industrial enterprises it calls as a rule for a large readjustment, it not a radical making over, of financial structure and operating plans and beyond that it calls for favorable conditions. The landowner will apply conservative woods practices (assuming that he knows what they are) only if and where he believes they will pay. No forester would undertake to advise a landowner that timber growing would constitute in his case a sound investment without first ascertaining whether the specific conditions are favorable. Very commonly they are not.

Favorable conditions include the factors which determine the yield that can be obtained—such as the present condition of the forest, the character of its soils, and the degree to which regional and local climatic conditions make for rapid growth. They include also the factors which determine the outlay necessary to obtain a given output—such as initial investment in land and timber, carrying charges, logging and manufacturing costs, and nearness to markets or transportation costs. And, finally, they include the market itself—that is, the price which can be expected for what is produced. Private forest management is going to come first where the economic conditions are most favorable—where the prospects of success in the new business venture involved are least dubious. It will be selective progressive, but gradual in its advance. That is one reason why, no matter how fast it extends (within the limits of the possible), it can not at best extend either fast enough or far enough to afford by itself a solution of the eastern forest problem. But it is important not to block its extension. On the contrary, a large part of the public effort must be directed toward making the conditions more favorable.

The urgent importance of doing this is obvious; for what is at stake is the efficient economic use and continuous

productiveness of the 336,000,000 acres of privately owned forest land in the East; of five-eighths the surface of New England, more than two-fifths of the Lake States, two-fifths of the mid-Atlantic States, and three-eighths of the South Atlantic and Gulf States. While here and there some small parts of this vast land surface give promise of being maintained under forest management, there is no assurance as to the future of the great bulk of it.

The things necessary to hasten the private application of forestry to as much of this land as possible are fairly well recognized: Security against excessive taxation, efficient systems of protection against fire, public research and demonstration of usable practices, and consistent, steady educational effort to win the acceptance of such practices. The danger that taxes may absorb all, if not more than all, that forest owners might be able to make through investing in management is by itself in many cases of determining weight. The tax question is one of great complexity. In various ways a number of States have tried to apply a solution. The most hopeful element in the situation at present is the extent to which the question is being grappled with. As for fires, the problem is simpler. It is essentially to develop more widespread public interest and greater financial support. For research, the authorizations carried by the McSweeney law propose a program which if put into effect through corresponding actual appropriations will increasingly make available the kind of knowledge that the private owner needs in order to practice forestry. And the enlarged program of national-forest acquisition which the \$8,000,000 authorization of the McNary-Woodruff law inaugurated will greatly augment the opportunities for demonstration. If the States keep pace with similar policies, the public program required to accelerate the spread of private forestry will be well rounded out.

FOREST-FIRE CONTROL BASIC

The beginning of forestry is fire control. Until fire is systematically kept out of the woods all attempts at permanent use of the land for timber growing must be abortive. It is impossible to establish reasonably full new stands in the face of even light periodic fires. Irrespective of who will eventually own forest lands, the first essential is to keep them from being reduced to worthlessness by fire. This is now generally recognized.

While the provision made to keep out fires from the forests of the East is still barely more than half of what is necessary for adequate protection, every Eastern State but one with considerable forests within its borders has initiated action.

In this field the thing to do, of course, is to carry to conclusion what has already been begun. That calls for a very material strengthening and extension of the established State systems of protection. These are maintained through cooperative Federal, State, and private expenditures. Widespread assent has seemed to be given the theory that a fair division of the burden of protection would be accomplished if the protected property paid one-half the cost, the Nation one-fourth, and the States one-fourth. The estimated total requirement for the East (exclusive of lands Federally owned) is about \$8,400,000. The expenditures last year were about \$2,400,000. Of this the States paid nearly \$1,700,000, the Federal Government less than \$800,000, and private owners less than \$200,000.

The Clarke-McNary law, passed in 1924, authorized an annual Federal appropriation for this work throughout the country of \$2,500,000. The appropriations actually made hitherto, however, have been far below the authorization. The largest is the one for the current fiscal year. Its amount is \$1,200,000. In comparison with the States, the Federal Government is not yet taking its proportionate share of the load.

THE PRIVATE OWNER'S PART IN PROTECTION

The greatest deficiency, however, in the East is in the share taken by the private owner, if the 2-1-1 ratio is anywhere near right. Eastern private forest owners are doing far less than western owners to protect their lands from forest fires. This is doubtless primarily because of the lower property risk involved. Cut-over lands, of course, have no such cash values exposed to destruction as virgin forests present; and western climatic as well as forest conditions make the average exposure there particularly severe. Eastern forest fires as a rule have their most serious effect in the destruction of young growth and the loss of soil value; they are more important from the standpoint of the future forest than from that of the present stand. Nevertheless, it is not without significance that private, State, and

Federal funds expended for the maintenance of organized protection systems outside the national forests have in the West the ratio of approximately 7-2-1; in the East, of approximately 2-10-3. Or, to state it in another way, western timberland owners put up last year toward the cost of fire protection under State authority \$7 for every \$3 disbursed by the State and Federal Governments combined, while eastern owners put up \$2 for every \$13 from the other two agencies.

Two possible ways are open to reduce or eliminate this deficiency—inducement and requirement. In the West the method of requirement has been developed. Timberland owners in the State of Washington, for example, who do not voluntarily contribute on an acreage basis to the protective associations have the cost of protection levied against their holdings by the State, as part of their taxes.

Obviously, in regions where the present tax burden is producing or threatens to produce extensive abandonment of title, a required contribution toward the cost of protection would tend to increase abandonment. The application of such requirements in the East should, it is believed, take place only as part of a comprehensive State policy of forestry, with the State prepared to take over the land if the private owner is unwilling to retain and partly meet the cost of protecting it and can not dispose of it to some one else who will. Lands thus taken over by the State should, of course, be given protection by the State itself and should, as rapidly as practicable, be built up into units suitable for permanent forest administration. This would require provision (1) that all forest lands becoming tax delinquent are, after a reasonable time, to be taken over by the State for forest purposes; (2) that an administrative agency of the State is to create consolidated holdings through further land acquisitions, where this is necessary, by purchase or exchange, lands taken over to be available for the latter purpose; and (3) that such consolidated holdings are to be thereafter administered as permanent State forests, under competent technical management.

Such a course if generally adopted in the East would have some obvious advantages. Not only would it tend to enlarge materially the now wholly insignificant proportion of the forests in public ownership, it should tend also to increase the interest of private

owners who hold and protect the land in the further application of forestry.

FOREST MANAGEMENT THE GOAL

Fire protection, of course, is not itself the practice of forestry; it is merely the preliminary, though essential, first step, to give the forest chance to live and perpetuate itself. Beyond that comes actual management. The cases in which private owners have as yet inaugurated forest management are, it must be admitted, relatively infrequent. But the percentage of lands under bona fide, systematic forest management is at the present time less important than which way the land is headed. Is it headed toward further depletion and eventual discarding, like a sucked orange, by the owner? Or is it headed toward permanent use for timber growing? Land whose owner has begun voluntarily to put money into conserving forest values is headed the right way. If requiring protection would substantially increase the amount of such land, it would to that extent improve the outlook.

Right use, however, can not be brought about by fiat. It is a matter quite as complex, difficult, and progressive as bringing about efficient agriculture. In fact, it is closely interwoven with the problem of the better use of our land for agricultural production. Forestry and agriculture are complementary and sometimes competing forms of land use. They have much in common. In considerable measure timber growing will take place as a part of diversified agriculture on farms. In regions like the South it calls, along with other things, for a large change in the conceptions and practices of the rural population relative to land use—the substitution of current and traditional methods of a more scientific, modernized agriculture; the remodeling of an out-of-date adjustment of those who make use of the soil to the resource by which they live; in a word, rural progress. It calls everywhere for a revolutionary change in the attitude of the great lumber industry toward its source of supply of raw material—a revolution fortunately already on the way. It calls alike for a truly tremendous undertaking in public education to bring about the introduction of right practices and for an equally formidable undertaking to find out what, under the most diverse regional and local conditions, the right and workable practices are.

WHAT NEEDS TO BE DONE

The salient facts regarding the forest problem of the country indicate on their face the main features of the public program that should be pursued. It should give full recognition to the conditions in the eastern half of the country, where by far the acutest phase of the problem is found and where almost all the forest land is privately owned. There plainly two major purposes need to be pursued. One of them is to hasten the economic process by which, in time, probably the major fraction of the present private forest land in the eastern half of the country—and for that matter in the West, too—will come to be used for timber growing by its owners, as a paying private enterprise. The other is to adopt public policies of forest-land acquisition and administration on a scale that will bring the East, without too long delay, into a situation more nearly comparable with that of the West and of every great nation of the civilized world having extensive forest resources.

In every part of the country it is important to check the forest deterioration caused by fire. The public protective systems now provided in nearly all the States having substantial forest areas must be made equal to this task. Almost nowhere are they as yet adequately supported, and in many States they are no more than introduced. Unless the 2-1-1 ratio of cost apportionment to the landowners, the State, and the Nation is to be discarded, the Nation must pay substantially more relatively to the States, and in the East private owners must as a rule pay much more, relatively to both. In some of the Southern States, however, private owners are now contributing more than the Federal Government and the State together.

But merely stopping forest fires is not enough. To become fully productive, forests must be skillfully managed, not merely held as wild lands. Timber-growing as a form of land management for private owners in the eastern United States can hardly be said as yet to have attained the status of even an infantry industry. A large part of the public effort in connection with forestry must be directed toward finding out the how and where of private forestry, and getting the results into practical use—toward research and industrial education. That is in itself a very large task. Fortunately, the new McSweeney-McNary law au-

thorizations give promise that it will be prosecuted with the vigor that its importance calls for.

This, however, is still not enough. At best, private forestry is going to advance only a step at a time, beginning where the conditions are most favorable. It will very gradually edge up on the core of the problem from one side; and it will never accomplish more than a partial solution. Public forestry must attack the core from the other side through State, Federal, and municipal forest acquisition, aimed primarily at obtaining (1) the land most necessary from the standpoint of watershed protection, recreation, and like public needs, (2) land which, under management, will tend most effectively to stimulate private interest in timber growing, and (3) land necessitating such outlays for its reclamation to good timber-growing conditions that not for a long time, if ever, will private capital make use of it.

A further question that must be faced is that of public policy respecting the land in the enormous twilight zone between the very few million acres which on the most optimistic estimate can be classed as now under private forest management and the few million more now under public administration, pending the time when it will be reached from one or the other side, in the course of decades, under the process outlined above. The application of management by private owners is in the nature of the case something that must come about as a voluntary choice on their part, if it comes about at all; the public has no power to compel it. On the other hand, the States unquestionably have it in their power to place on timberland owners at least a part of the cost of maintaining a general system of fire protection, for in some States this is now being done. Where States are prepared to take over tax-reverting lands and build them up into publicly managed forests, requiring private owners to contribute toward the cost of protecting their lands would presumably accelerate the reduction of the twilight zone from both sides. It would also prevent the deterioration which fire causes without compelling the public to bear the entire expense where the private owner wants to play a waiting game, holding off from expenditures until he can see whether it will pay best to hold the land permanently or to abandon it—a game for him of heads I win and tails you lose.

WHAT IS BEING DONE

The Federal Government has been cooperating with the States for 17 years in the prevention and suppression of forest fires, largely to stimulate and make profitable the growing of timber by private owners. The Weeks law of March 1, 1911, was the first Federal-aid law embodying the 50-50 principle of cooperation. It provided for protecting from fire the forested watersheds of navigable streams, in cooperation with any State that would spend in the same year an amount at least equal to the Federal expenditure. Fire protection is the activity around which Federal and State cooperation in forestry has developed. A Federal appropriation of \$200,000 was originally made, to be available until expended; but in three years this experiment in cooperative forest protection—for it was admittedly only an experiment—had sufficiently progressed to satisfy Congress that a yearly appropriation was needed.

It was not, however, until the Clarke-McNary law superseded the Weeks law in this field, on June 7, 1924, that a definite Federal responsibility to protect private and State forest lands as such from fire was recognized. It took form in an authorization of Federal appropriations of \$2,500,000 annually, which is based on the premise that the total estimated annual cost for all private and State lands needing protection, \$10,000,000, should be borne equally by the private owners and the public, with the public share divided equally between States and the Federal Government.

A survey of the progress made in these 17 years of cooperation shows a really remarkable growth. Beginning with 11 States, cooperation is now extended to 38, no less than 25 of which were stimulated to adopt protection by the offer of Federal cooperation. As new States have come in, it has been evident that the backing from Federal cooperation has helped to stabilize the protection once it was started, to place it on a permanent footing, and to extend it. The moral support of the Federal Government, the community of interest between the Government and States, and the joint effort to develop a new State function in furtherance of that interest have all counted heavily in the progress of the cooperation.

Annual expenditures by the States have increased from a few hundred thousand dollars to \$2,000,000, and the same is true of expenditures by pri-

vate owners. Federal expenditure though still less than half the \$2,500,000 contemplated by the Clarke-McNary law, have risen from \$50,000 to \$1,200,000. The area of State and private forest lands protected has been extended to over 200,000,000 of the 381,000,000 acres in need of protection. Yet with this remarkable showing the States and private owners together are meeting their responsibility in the matter by less than 60 per cent and the Federal Government its responsibility by only 40 per cent. Larger provision must be made.

The satisfactory showing already made in funds appropriated and acreage protected has been accompanied by an even greater progress in the handling of the protective work and in the results obtained. The administration of the work by the States is becoming less and less political and more and more efficient, which has made for larger returns on the money expended. The fire loss, in acreage burned and damage incurred, has been materially decreased. This is the real measure of progress. There has been an enormous increase in the exposure to fire, in consequence of greater facilities for travel and more people getting into the woods. There has also been an enormous increase in the cut-over areas, often highly inflammable. During 1926, which was a year of severe fire damage in various regions, nearly 85,000 fires were reported on private and State forest lands, the largest number on record. Nevertheless, the area burned, 23,500,000 acres, and the damage, \$22,000,000, were appreciable below the previous year, which was itself rather under the average in both items.

The Clarke-McNary law greatly broadened the cooperative work in other ways than by removing the restriction that limited protection to the watersheds of navigable streams. It laid down a comprehensive program of national forestry. It directed the Secretary of Agriculture to cooperate with the States or other suitable agencies for the study and devising of tax laws with a view to encouraging timber growing and for the promotion of timber insurance. No timber-insurance studies have yet been made, but tax studies have been under way for the past three years; they are discussed in another part of this report. The law also provided for the cooperative encouragement of farm forestry through distributing forest planting stock and through assistance in the practice of forestry.

The purpose was to enable the farmer to get the kind and quantity of trees needed for his shelter belt or wood lot at a cost which he can afford, and to get the assistance which he needs in growing timber crops. Admirable as were these provisions, they obviously should be extended to cover lands in all classes of ownership, including lands owned by States, municipalities, and especially the larger forest owners. To do so would greatly broaden the cooperative field of education and demonstration, and would undoubtedly lead to a more general practice of private forestry. The latter should be through the employment by large landowners of competent private practitioners, not through the development of a free service provided at public expense; the public function should be limited to showing the way.

State legislation, administration, education, and demonstration are helping to make private timber growing profitable. The essential first step in State forestry is the organization of a forestry department, now established in 44 of the States and in nearly all within the past two decades. The outstanding effort in the timber States is very naturally fire protection, while that in the Great Plains is the establishment of shelter belts and wood lots on the farms. Great strides have been made in analyzing the causes of forest fires and taking the necessary steps to reduce the hazard. Disposal of slash and debris after logging is increasingly required; brush burning by farmers is being controlled through requiring permits to burn; railroad fires are more and more successfully controlled. Such basic means of reducing man-caused fires are permitting the State protective systems to function on an increased basis of efficiency.

A rapid development of forest-tree nurseries in the States is the result of an enormous increase in the demand for planting stock by private owners. Last year the number of trees distributed to private owners, mostly at cost, was close to 60,000,000, of which New York and Pennsylvania produced approximately 25,000,000 and 15,000,000, respectively. Yet with all that Federal and State agencies are accomplishing cooperatively to induce private owners to reforest their cut-over lands and to make it profitable for them to engage in growing timber, there is an enormous further field for education and demonstration work. The Forest Service is so shaping its

public relations activities as to cooperate with the States and private owners on a larger educational plan than has been possible hitherto, and every effort will be made to obtain increased participation in fire prevention and continuous timber production.

PROGRESS IN STATE FORESTRY LEGISLATION

Tax relief is being given serious consideration in various States. Notable among the forest tax laws that have been passed, and in the forestry legislation enacted during the past year, is that of Wisconsin, the first and as yet the only State to recognize the principle of financial assistance to the local taxing unit during the period of exemption or until returns from the yield tax begin to come in. A tax on cut-over land of 10 cents an acre is to be matched by a like payment from the State, the latter to be eventually compensated through a yield tax of 10 per cent of the value of the forest products when harvested. This law supplemented the constitutional amendment mentioned in last year's report.

Although few State legislatures held sessions last year, considerable other forestry legislation was enacted. Of greatest significance is that looking to enlarged public ownership and administration.

Mention was made in last year's report of the introduction in the New York Legislature of a resolution contemplating a constitutional amendment to authorize a bond issue of \$100,000,000 for buying and reforesting lands during a 20-year period. At last winter's session the legislature created a temporary commission to investigate the subject of reforestation generally, to gather data on the lands not suitable for agriculture which might be utilized for that purpose, and to report upon the best means of promoting and financing the work. In other words, legislation has been passed to ascertain the facts and to devise a practicable course of action. The comprehensive scale upon which this work is planned may be widely influential in other States. New York also authorized villages to acquire and use lands for forestry purposes, and authorized the State conservation department to establish and manage new State parks and parkways in the forest preserve and certain other counties and to acquire land for them as appropriations for purchases are made.

Wisconsin changed its single-headed conservation commission to one of six members, with power to employ a conservation director; revised and ex-

panded the commission's general powers and duties for the protection, development, and use of forests; and increased from 100,000 to 500,000 acres the authorization for Federal land acquisition for national forests, the general boundaries to be subject to approval by the county boards. Porto Rico likewise authorized the United States to acquire land for the extension of its national forest.

Alabama passed a progressive measure looking to the discovery by the State commission of forestry of all lands to which the State, its institutions, or departments are entitled, but which have not been received, and to the classification of all lands of the State or its townships from the standpoint both of their present use and of that for which they are chiefly valuable. State lands not being utilized for the immediate purposes of the individual institutions or departments, and all State parks, are placed under the jurisdiction of the commission, which is required to protect and recommend policies for them, may recommend exchanges of scattered tracts to consolidate ownership, and must determine and list with the auditor all State unused lands which are best suited to forest culture. Thereafter at the direction of the governor lands so listed are to be administered by the commission as either State forests or State parks.

Somewhat similarly, West Virginia created a State forest and parks commission (consisting of the governor and four other State officials) to investigate lands held by the State, including lands forfeited through non-payment of taxes; to determine their availability for State forests or parks; and to report to the next legislature, regarding how best to cooperate with the Federal Government in connection with its plans for the Monongahela National Forest, regarding State forests and parks generally, and specifically regarding the availability and usefulness for forest or park purposes of various named areas.

Kentucky, in anticipation of Federal purchases within that State for national-forest purposes, provided that moneys accruing from national forests shall be apportioned to the several counties in proportion to the national-

forest area in each, for public school and roads. Massachusetts made provision for forest-fire patrol in certain towns on Cape Cod. New Jersey extended its forest fire protection laws to include salt marshes or meadows, and New York increased the maximum pay of fire wardens and fire fighters and empowered the conservation department to enter into cooperative agreements with municipalities and persons for fire control.

WORK OF THE YEAR IN STATE COOPERATION

The appropriations for cooperative work with States during the fiscal year 1928 compared with those for the previous year and those for the fiscal year 1929 are shown in Table 1.

TABLE 1.—*Appropriations for State cooperation, 1927-1929*

Item	Amount appropriated for fiscal year—		
	1927	1928	1929
For the prevention and suppression of forest fires and for the forest taxation inquiry (secs. 1-3 of the Clarke-McNary law)-----	\$710,000	\$1,000,000	\$1,200,000
For the distribution of forest planting stock to farmers (sec. 4 of the same law)-----	75,000	75,000	75,000
For farm forestry extension (sec. 5 of the law)-----	50,000	60,000	60,000

The Federal expenditures last year under the first and second items appear in the statement of expenditure on page 59. The appropriation under the third item is expended by the Extension Service of the Department of Agriculture. The results of the work are summarized below, except for the taxation study, which is covered on page 55. Table 2 shows in detail the Federal, State, and private funds disbursed by the States or expended under their direct supervision for the prevention and suppression of forest fires, and the Federal and State funds disbursed by the States for the distribution of planting stock.

TABLE 2.—Cooperative expenditures in fire protection and the distribution of forest planting stock under the Clarke-McNary Act, fiscal year 1928

State	Fire protection				Distribution of forest planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Maine.....	\$36,897.33	\$151,080.27		\$187,977.60	\$1,499.88	\$1,550.76	\$3,050.64
New Hampshire.....	12,136.00	39,483.72	\$7,988.58	59,608.30	2,052.78	5,273.37	7,326.15
Vermont.....	7,028.00	7,105.64	6,404.21	20,537.85	2,200.00	6,944.16	9,144.16
Massachusetts.....	19,420.00	82,438.94		101,858.94	2,200.00	10,293.75	12,493.75
Connecticut.....	6,166.95	34,850.56	5,117.51	46,135.02	2,000.00	3,060.70	5,060.70
Rhode Island.....	983.00	4,121.99		5,104.99			
New York.....	42,472.00	217,976.28		260,448.28	4,100.00	88,083.47	92,183.47
New Jersey.....	10,504.00	86,610.11		97,114.11	2,100.00	5,357.41	7,457.41
Delaware.....	765.00	997.67		1,762.67	2,000.00	2,880.00	4,880.00
Pennsylvania.....	37,628.00	205,519.33		243,147.33	2,800.00	25,826.65	28,626.65
Maryland.....	6,809.00	25,597.92	2,640.82	35,128.74	2,100.00	6,841.03	8,941.03
Ohio.....	2,913.00	18,987.12		21,900.12	2,200.00	16,357.91	18,557.91
Illinois.....	525.70	3,608.62	1,050.00	5,184.32			
Indiana.....	1,609.03	1,722.29		3,331.32	2,137.94	13,127.89	15,265.83
Iowa.....					2,000.00	2,946.37	4,946.37
Virginia.....	32,491.00	33,018.38	10,258.00	75,767.38	2,000.00	2,526.14	4,526.14
West Virginia.....	18,232.00	37,274.14	17,123.55	72,629.69	200.00	248.75	448.75
North Carolina.....	41,438.00	43,103.59	2,694.19	87,235.78	2,000.00	3,271.19	5,271.19
South Carolina.....	3,400.00	639.09	8,451.84	12,490.93			
Kentucky.....	10,114.50	10,114.50		20,229.00	1,684.70	2,166.93	3,851.63
Tennessee.....	22,750.00	19,697.09	8,737.09	51,184.78	1,000.00	1,016.00	2,016.00
Georgia.....	38,338.00	10,584.64	30,088.55	79,011.19	800.00	800.00	1,600.00
Florida.....	9,000.00	9,000.00		18,000.00	35.00	35.00	70.00
Porto Rico.....					2,300.00	15,544.16	17,844.16
Alabama.....	41,760.00	36,051.15	21,708.28	99,519.43	1,058.97	1,058.97	2,117.94
Louisiana.....	35,607.00	40,569.21	62,165.20	138,341.41	2,100.00	10,653.21	12,753.21
Mississippi.....	33,655.00	13,623.57	45,997.44	93,276.01			
Texas.....	30,862.00	30,774.43	3,012.70	64,649.13			
Oklahoma.....	13,710.00	6,790.65	8,007.00	28,507.65	2,000.00	2,730.74	4,730.74
Missouri.....	6,747.36	6,654.36	93.00	13,494.72	1,600.00	1,635.34	3,235.34
Michigan.....	54,804.00	304,311.00		359,115.00	2,100.00	5,534.27	7,634.27
Wisconsin.....	27,276.00	72,067.68		99,343.68	2,000.00	5,443.14	7,443.14
Minnesota.....	60,933.00	180,587.78		241,520.78			
Kansas.....					2,000.00	4,000.02	6,000.02
Nebraska.....					2,000.00	4,112.00	6,112.00
Colorado.....					1,776.00	2,022.41	3,798.41
South Dakota.....	375.00	4,821.85		5,196.85			
Wyoming.....					1,000.00	1,519.68	2,519.68
North Dakota.....					2,100.00	9,437.50	11,537.50
Montana.....	18,708.00	15,892.14	39,324.41	73,924.55	2,000.00	2,628.62	4,628.62
Idaho.....	35,608.00	52,505.23	129,466.88	217,580.11	1,171.00	1,201.00	2,372.00
Washington.....	50,955.00	107,689.65	205,328.90	363,973.55	2,000.00	2,778.15	4,778.15
Oregon.....	48,442.00	42,783.79	213,462.17	304,687.96	2,000.00	2,715.20	4,715.20
California.....	44,985.00	110,901.54	168,723.04	324,609.58	942.50	1,759.91	2,702.41
Hawaii.....					1,805.26	28,282.67	30,087.93
New Mexico.....	1,826.00	5,149.00		6,975.00			
Administration and inspection.....	73,320.85			73,320.85	175.00		175.00
Total.....	941,275.72	2,074,705.52	997,843.36	4,013,824.60	69,239.03	301,664.47	370,903.50
Forest tax studies.....	49,838.05						
Cost of Norway pine seed on hand June 30, 1928, subject to requisition by cooperating States.....					5,737.95		5,737.95
Unexpended balance.....	8,886.23				23.02		
Total appropriation.....	1,000,000.00				75,000.00		

In addition to the expenditures for fire protection shown in Table 2, probably in excess of \$1,000,000 was expended independently by private individuals and associations. In some States a very substantial contribution is thus made to the total protective work.

COOPERATIVE PROTECTION OF STATE AND PRIVATE FORESTS FROM FIRE

Cooperative study of protection requirements for each forest region of the United States is authorized and required by section 1 of the Clarke-McNary law. State forestry departments were the agencies cooperated with, and the studies made concerned their forest-fire protection problems and the formulating or approving of programs and plans calculated to provide adequate protection. Such studies were completed in Mississippi, Oklahoma, Wisconsin, and Virginia.

The Cape Cod forest-fire prevention experiment, begun in January, 1926, was continued. Its aim is to determine the effectiveness of intensive educational prevention work in fire control, as against suppression work solely. From the start there has been a marked and continuous reduction both in the area burned and in the cost of protection.

Progress was made upon studies in Washington and Oregon. In the Southeast fact-finding surveys are being continued. The aim will remain to formulate a program for each region or State, to which all parties are agreed and for which all will strive.

Cooperative agreements for organized fire protection were in force with

38 States, or 5 more than the previous year; the new States were Indiana, Illinois, Delaware, Florida, and South Carolina. All States having substantial areas of State and private forest land in need of protection are now cooperators in this activity except Arkansas. The area covered in the calendar year 1927, about 202,000,000 acres, exceeded that in 1926 by 14,000,000 acres. Yet only 54 per cent of the entire amount needing protection was covered, and a substantial part of that very inadequately.

For the area under protection the 1927 record (shown in Table 3) compares very favorably with that of 1926. With 4 per cent more fires, the area burned was over 40 per cent less. More substantial progress is indicated in the suppression than in the prevention of fires. Including unprotected lands, however, the total area burned in 1927 was 59 per cent greater than in 1926. This was due to severe fires in the relatively unprotected southeastern and Gulf regions, where nearly 35,000,000 acres were burned or areas classed as unprotected. It is significant that while only one-third of the area needing protection is unprotected, 93 per cent of the total area burned was on this third. It is true that the record of fires on unprotected areas is not complete or accurate. After all allowances have been made, however, for inaccuracies in the data it is obvious that the greatest single immediate need is to extend protection to the 170,000,000 acres and more of forest land which is still in the unprotected class.

TABLE 3.—*Summary of forest fire statistics, by groups of States, for the United States, exclusive of Alaska, calendar year 1927*

[Figures for unprotected areas based upon partial information only]

Group of States ¹	Number of fires				Damage			
	On protected area	On unprotected area	Total	Per cent	On protected area	On unprotected area	Total	Per cent
United States.....	35,300	123,138	158,438	100.0	\$4,297,400	\$29,088,200	\$33,385,600	100.0
Northeastern.....	4,449	-----	4,449	2.8	800,380	-----	800,380	2.4
Middle Atlantic.....	2,516	99	2,615	1.7	399,320	95,040	494,360	1.5
Southeastern.....	2,142	26,734	28,876	18.2	483,520	13,837,960	14,321,480	42.9
Gulf.....	12,989	85,341	98,330	62.1	998,010	14,421,780	15,419,790	46.2
Central.....	899	10,932	11,831	7.5	183,910	670,410	854,320	2.5
Lake.....	3,130	-----	3,130	1.9	100,820	-----	100,820	0.3
Rocky Mountain.....	2,569	29	2,598	1.6	29,550	12,530	42,080	0.1
Pacific.....	6,606	3	6,609	4.2	1,301,890	50,480	1,352,370	4.0

Northeastern group—New England States and New York. Middle Atlantic group—New Jersey, Pennsylvania, Delaware, and Maryland. Southeastern group—Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida. Gulf group—Alabama, Mississippi, Louisiana, Texas, Oklahoma, and Arkansas. Central group—Kentucky, Tennessee, Ohio, Indiana, Illinois, and Missouri. Lake group—Michigan, Wisconsin, and Minnesota. Rocky Mountain group—Montana, Idaho, Wyoming, South Dakota, Colorado, Arizona, New Mexico, Nevada, and Utah. Pacific group—Washington, Oregon, and California.

TABLE 3.—*Summary of forest fire statistics, by groups of States, for the United States, exclusive of Alaska, calendar year 1927—Continued*

AREA, IN ACRES, BURNED

Group of States ¹	On protected area							On un-protected area	Grand total	Per cent
	Forest land				Non-forest land	Total	Per cent			
	Mer- chant- able or mature tree growth	Unmer- chant- able or im- mature tree growth	No. tree growth at present	Pro- tec- tion for- est						
United States.....	587,070	1,095,020	441,700	85,580	575,080	2,784,450	100.0	35,747,380	38,531,830	100.0
Northeastern.....	20,680	45,650	48,210	-----	10,440	124,980	4.5	-----	124,980	.3
Middle Atlantic.....	17,730	39,430	13,920	-----	3,190	74,270	2.7	11,880	86,150	.2
Southeastern.....	117,920	198,430	36,460	580	21,950	375,340	13.5	16,481,770	16,857,110	43.8
Gulf.....	316,200	624,210	242,680	5,340	8,710	1,197,140	43.0	18,336,870	19,534,010	50.7
Central.....	59,330	34,310	1,510	-----	360	95,510	3.4	809,560	905,070	2.3
Lake.....	490	61,150	55,010	-----	19,950	136,600	4.9	-----	136,600	.4
Rocky Moun- tain.....	10,970	4,330	2,230	2,570	1,250	21,350	.7	13,360	34,710	.1
Pacific.....	43,750	87,510	41,680	77,090	509,230	759,260	27.3	93,940	853,200	2.2

¹ Northeastern group—New England States and New York. Middle Atlantic group—New Jersey, Pennsylvania, Delaware, and Maryland. Southeastern group—Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida. Gulf group—Alabama, Mississippi, Louisiana, Texas, Oklahoma, and Arkansas. Central group—Kentucky, Tennessee, Ohio, Indiana, Illinois, and Missouri. Lake group—Michigan, Wisconsin, and Minnesota. Rocky Mountain group—Montana, Idaho, Wyoming, South Dakota, Colorado, Arizona, New Mexico, Nevada, and Utah. Pacific group—Washington, Oregon, and California.

COOPERATION WITH THE STATES IN TREE PLANTING

On July 1, 1925, when the Clarke-McNary law became effective, 18 States were distributing forest trees to their citizens for planting as against 37 States and 2 Territories which are now receiving Federal co-operation in this work. Public demand for low-priced forest trees so necessary to reforestation is extensive and growing. Last year five new States, Georgia, Florida, Mississippi, Tennessee, and West Virginia, received this form of aid.

Many of the cooperating States have difficulty in obtaining tree seeds at a reasonable cost. Particularly has this been true of Norway pine, which is being extensively planted in Northern States. The Forest Service therefore inaugurated last fall a cooperative seed collection and extraction project on the Chippewa National Forest in Minnesota. The States which shared in the cost were furnished 1,931 pounds of Norway and 269 pounds of white pine seed at a relatively low cost per pound, and 1,400 pounds more is still available. There is probably enough Norway pine seed to meet the needs of the cooperating States for the next two or three years. To insure a steady and reliable supply of seed for their own needs, New York

and Louisiana have erected State extraction plants.

Farmers throughout the country are becoming steadily more appreciative of the desirability of keeping their woodlands fully stocked and of making their idle acres produce timber crops. Last year they planted with young trees over 30,000 acres of farm lands, and the cooperating States distributed to them nearly 28,000,000 trees to plant, while additional stock was purchased by farmers from private nurseries.

The allotments made to the States cooperating and their expenditures were shown in Table 2.

COOPERATION WITH THE STATES IN FARM-FORESTRY EXTENSION

Two new States included forestry in their agricultural-extension programs, bringing the number to 31. This work, authorized under section 5 of the Clarke-McNary law, is conducted as a part of the extension program of the several State agricultural colleges and is administered by the Extension Service of the department with the cooperation of the Forest Service. The Federal appropriation for the year of \$60,000 was used mostly for the employment of extension foresters.

In number of projects planting took first place. County agricultural agents reported 6,082 forest plantings, covering 19,455 acres, and 1,924 wind-breaks. The management of already established farm woodlands, though of greater economic importance than forest planting on waste farm lands, does not so easily appeal to the owner. Nevertheless 4,509 farmers received assistance toward the management of 222,135 acres of woods. An interesting development of the work was the employment in Chautauqua County, N. Y., of an assistant county agent to serve as county forester.

The most notable feature of the year was the extent to which forestry was taken up by the boys and girls of the 4-H clubs. In addition to forest planting and projects designed to inculcate a better knowledge of the forest and forest values the management of pieces of farm woods was undertaken, with thinnings and improvement cuttings; and in Louisiana, in cooperation with the State forester, a plan was developed for protecting woodland from fire. In all, 3,163 boys and girls, largely in five States, enrolled in forestry projects, and 2,192 carried their work to completion.

NATIONAL-FOREST ADMINISTRATION

The total cost of national-forest administration, protection, improvement, and extension last year, exclusive of expenditures for the administration of the Forest Service as a whole (i. e., general overhead) was \$20,117,615.90. This was less by \$1,237,800.96 than the cost for the fiscal year 1927. A relatively favorable fire year reduced the expenditures for protection by \$1,581,665.02, and \$895,909.47 less was spent on road and trail construction and maintenance; but \$998,551.99 more was spent for land purchases, and smaller increases took place in various items.

As the statement of expenditures and receipts on page 59 shows, the cost of administering the current business on the national forests was considerably less than half the receipts. The basic object of the public enterprise, however, is not money returns but public benefits of many kinds. It is true that the taxpayers of the country have a right to expect that the national forest administration will seek to make their burden as light as possible—that in making expenditures it will have careful regard for econ-

omy and that commercial uses of the forests will be made revenue producing in accordance with and on the basis of their value. There is ground for satisfaction that the cost of operating the forests is being more than met by the cash receipts, mainly from timber and grazing. But in addition large and important returns to the general welfare were realized; and these were the real profits of the enterprise.

The national forests are, of course public investments. In connection with the census estimate of the national wealth, made in 1922, their value was put at \$1,053,191,993. This represents a theoretical appraisal of great land areas largely having no established market value. While any attempt to set up a money equivalent for them is necessarily guesswork, the fact remains that when the forests were established they already represented very substantial public investment and each year adds to the total. The forest resources are steadily appreciating national assets. The major part of the annual outlay upon them is for their development, equipment, and extension, and under the accounting methods of private business would be properly chargeable to capital account. Even the cost of protection is largely an expenditure for the future, or carrying charge. The character of the public enterprise necessitates substantial outlays to establish, equip, and develop the forests, and it is sound business policy to add in this way to what in a balance-sheet statement would be recorded as the book value of the investment.

The administrative and protective improvements on the national forests exclusive of roads and trails, have present inventory value of \$6,365,745. These include lookout towers and houses, telephone lines, ranger quarters, etc. At the close of the fiscal year there were 14,822.6 miles of road and 39,594.6 miles of trail, representing a total outlay of \$72,717,912.02 of Federal and \$16,879,492.78 of cooperative funds. In addition there are range and recreation improvement constructed at a total cost of \$1,233,739, partly Federal and partly cooperative funds. These various classes of improvements have added enormously to the public usefulness of the forests and to their value as properties.

The appropriations of Federal funds for the national forest enterprise in the fiscal years 1927, 1928, and 1929 compare as shown in Table 4:

TABLE 4.—*Appropriations of Federal funds, 1927-1929*

Item	1927	1928	1929
General expenses of administration, protection, and improvement.....	\$6,358,838.00	\$6,488,865.00	\$6,814,600.00
Specifically for—			
Fire and insect control.....	2,488,000.00	1,180,107.46	71,892.54
Improvements, tree planting, land and resource surveys, and land adjustments.....	862,150.00	880,450.00	996,450.00
Land acquisition.....	1,000,000.00	1,994,843.40	1,005,156.60
Roads and trails (construction and maintenance) needed primarily for forest protection and development.....	2,876,705.03	4,654,086.78	3,540,511.91
Highway construction and maintenance primarily to meet public needs, as a recognition of Federal responsibility created by ownership of untaxed lands.....	4,037,500.00	4,240,000.00	4,500,000.00

Contributed cooperative funds brought the total available for 1927 to \$19,224,421.08, and for 1928 to \$20,926,170.03. In addition, the appropriations for roads and trails were augmented by unexpended balances from earlier years. The total so carried forward into the fiscal year 1927 was \$2,822,815.76; into 1928, \$5,019,167.12; and into 1929, \$4,462,848.45. Both because of this carry over and because most of the road funds become available for expenditure as soon as the appropriation act carrying them is passed, road and trail expenditures for individual years do not correspond closely with the appropriations.

The increase for 1928 over 1927 shown in the third item was made to provide \$18,300 more for tree planting; and that shown in the first item provided \$70,500 more for fire guards and other forms of preparedness, \$46,000 for increased personnel to handle the expanding timber-sale business and the grazing work, \$10,527 for administering the military-reservation national forests, and \$3,000 for the purchase and establishment on the Wichita National Forest of a herd of longhorn cattle.

The 1929 further increase in the third item represents \$60,000 more provided for tree planting, \$52,000 for the construction of improvements to assist in fire control—of which \$25,000 was for use in southern California—and \$9,000 for the construction of a dam on Cass Lake in Minnesota. The 1929 gain in the first item (\$325,735) was partly due to a shift into this item of \$75,000 formerly carried in the second item. It also provided \$37,800 more for the timber sale and range management work and \$238,528 more for the payment of salaries and expenses in connection with fire control. On the other hand, decreases totaling

\$25,593 were effected by dropping the longhorn cattle herd item (the work having been accomplished), by curtailing slightly the provision for Washington office expenditures in connection with national forest administration, and by carrying to the appropriation for the Federal Power Commission \$19,400 previously used to perform work required by that body.

The showing under the item "Specifically for fire and insect control" needs comment. The greater part of the cost of fighting forest fires is covered, not by appropriations made in advance, but by subsequent deficiency appropriations according to the amount required. Severe conditions in 1927 necessitated a deficiency appropriation in that year of \$2,155,000. The 1928 deficiency appropriation of \$769,000 was supplemented by \$78,107.46 from a 1929 \$100,000 fire fund; only the remaining balance therefore appears as appropriated for 1929. A 1929 deficiency appropriation of at least \$1,000,000 will probably have to be sought when Congress convenes.

In bad fire years the funds available for general expenses of administration, protection, and improvement are drawn upon much more heavily for fire control than in normal or exceptionally favorable years, and the deficiency appropriations in the severe years only partly meet the extra cost. In other words, the regular appropriations have a degree of fluidity which causes considerable fluctuation in the amounts available from year to year for other purposes than protection.

With regard to the fourth item in the comparative statement of appropriations, it should be said that both the 1928 and the 1929 agricultural appropriation acts provided \$1,000,000 for land acquisition. Following the enactment of the McNary-Woodruff law au-

thorizing a 1929 appropriation for this purpose of \$2,000,000, another \$1,000,000 was provided for 1929 in a deficiency act, but with the provision that it should be available for immediate expenditure. This was to permit exercise of an option to purchase the so-called Waterville tract, in New Hampshire, which otherwise would have lapsed. The expenditure actually made in 1928 is included in the amount shown as appropriated for that year and is correspondingly deducted from the 1929 total.

The two chief expenditure items in administering the national forests are improvements and protection. These are closely related. The first and most imperative reason for equipping the forests with improvements has been to lessen the cost and increase the efficiency of protection.

As is stated later on this page, the national forests include within their boundaries more than 184,000,000 acres. When originally established they were principally vast areas of primeval wilderness. Their protection called for almost superhuman efforts, was expensive in comparison with what could be done, and yet left the forests exposed to severe losses. Fires had to be fought by men barehanded, so to speak; there was no system either for detection or suppression. It often took days and sometimes weeks to cut a way through to a fire, and the provision made for detection was as primitive, unequipped, and defective as that for suppression.

As is mentioned in the section dealing with roads and trails, a multitude of concrete cases could be cited in which roads and trails have been the direct means of saving the Government, sometimes in a single year, far more than they cost to build. Protection improvements making it possible first to discover and report fires quickly and then to attack them swiftly are invaluable aids to keeping down losses and employing to good advantage the funds spent each year in fire control. In short, adequate equipment of the forests with the improvements necessary to preserve their resources and to enable the public to use them is basic to carrying out the purpose for which they were created and is a highly economical form of expenditure.

While large progress has been made, much remains to be done before the forests will be properly equipped for economical and efficient protection and for rendering fully to the public the services and benefits which constitute

the real returns on the national investment in them. The section dealing specifically with their protection against fire indicates in more detail the urgent needs from that standpoint. It is important also to increase their value for timber production by enlarging greatly the tree-planting work.

As already noted, the 1928 appropriations provided for some enlargement of this work, and those for 1929 have considerably but by no means adequately increased the provision. The creation of new purchase areas in the Lake States and the South, mentioned on page 22, increases the need. These new areas will be made up largely by the purchase of lands on which a valuable timber crop can be established only through tree planting. On the already-existing national forests extensive areas await planting to become productive. They are largely old burns denuded of valuable timber growth before the national forests were created, and still not restocking. New fires add each year something to such areas, and in bad seasons add far more than is replanted at the present far too meager rate. Not counting such additions and the enlarged requirements that will be imposed by the new acquisition program, at the rate of last year's planting, totaling only 12,803 acres, more than 160 years would be necessary to complete the reforestation definitely needed now. This is another form of investment that should be recognized as both profitable and essential to proper development of the forests as useful public properties.

THE NATIONAL-FOREST PROPERTIES

The gross area of the national forests on June 30, 1928, was 184,403,811 acres, of which 24,922,963 acres were not owned by the United States. The net area was therefore 159,480,850 acres. The gross area increased 465,713 acres, the net area 680,432 acres.

By Executive orders, 169,502 acres of military reservations, administration of which as national forests was found impracticable under the plan of the War Department, were removed from national-forest status. This abolished the national forests on Camp Benning, in Georgia; Camp Dix, in New Jersey; Camp Eustis, in Virginia; Camp Jackson, in South Carolina; Camp Knox, in Kentucky; Camp Lee, in Virginia; Camp Meade, in Maryland; Camp McClellan, in Alabama; and Camp Pine Plains, in New York. On the other hand, area recomputations based on better surveys and land

data raised the gross area showing by 57,648 acres; 31,741 acres were added by exchanges consummated with private owners of lands adjoining the old forest boundaries; and 39,000 acres was acquired in Michigan under section 6 of the Clarke-McNary law and thereby automatically added to the Michigan National Forest. All other gross area changes of the fiscal year are listed in Table 5.

TABLE 5.—*Additions to and eliminations from the gross areas of the national forests made by acts of Congress, Presidential proclamations, Executive orders, and State land exchanges*

National forest	State	Additions	Eliminations
		<i>Acres</i>	<i>Acres</i>
Challis.....	Idaho.....	¹ 76, 379	-----
Cherokee.....	Georgia, North Carolina and Tennessee.....	² 200, 188	² 186, 230
Chugach.....	Alaska.....	³ 7, 361	-----
Columbia.....	Washington.....	-----	³ 1, 938
Colville.....	Washington.....	-----	³ 275
Crater.....	Oregon.....	¹ 27, 547	-----
Gunnison.....	Colorado.....	¹ 6, 364	-----
Harney.....	South Dakota.....	-----	³ 2, 883
Harney.....	South Dakota.....	-----	¹ 1, 600
Idaho.....	Idaho.....	¹ 46, 086	-----
Lassen.....	California.....	-----	¹ 80
Manti.....	Utah.....	¹ 125	-----
Missoula.....	Montana.....	¹ 227, 533	-----
Montezuma.....	Colorado.....	¹ 21, 557	-----
Natural Bridge.....	Virginia.....	² 1, 200	² 41, 670
Ozark.....	Arkansas.....	² 122, 489	-----
Plumas.....	California.....	² 4, 900	-----
San Bernardino.....	California.....	-----	³ 80
Sawtooth.....	Idaho.....	¹ 8, 724	-----
Sequoia.....	California.....	-----	² 37, 425
Sitgreaves.....	Arizona.....	-----	³ 140
Snoqualmie.....	Washington.....	-----	⁴ 4, 643
Stanislaus.....	California.....	² 10, 146	-----
St. Joe.....	Idaho.....	-----	⁴ 1, 130
Tongass.....	Alaska.....	-----	³ 1, 314
Umatilla.....	Washington and Oregon.....	² 16, 271	-----
Wallowa.....	Oregon.....	² 7, 756	-----
Wenatchee.....	Washington.....	² 161	-----
Whitman.....	Oregon.....	² 1, 447	-----

¹ Made by acts of Congress.

² Made by Presidential proclamation.

³ Made by Executive order.

⁴ Made by State land exchange.

The additions to the Challis, Sawtooth, Idaho, Missoula, and Gunnison Forests were approved by the National Forest Reservation Commission under section 8 of the Clarke-McNary Act. The presidential proclamations adding to the Plumas, Stanislaus, Wallowa, Whitman, Wenatchee, and Umatilla Forests were under the authority of specific acts of Congress. The elimination from the Sequoia National Forest in

California was made because the character of the land does not justify its further administration. The 1,600-acre elimination from the Harney National Forest in South Dakota comprised scattered tracts lying within the boundaries both of the forest and the Custer State Park, and were granted to the State for park purposes. Approximately 5,000 acres was conditionally transferred from the Powell National Forest, Utah, to the Bryce Canyon National Park by act of Congress, which also transferred the 80 acres shown as eliminated from the Lassen National Forest to the Lassen Volcanic National Park, to meet administrative needs of the Park Service.

While distinct progress was made during the year toward a logical shaping up of the national-forest properties, much remains to be done. Unreserved and unappropriated public lands chiefly valuable for stream-flow protection or timber production, and near enough to existing national forests to be efficiently and economically managed as parts of them, should be given a national-forest status. It was the purpose of section 8 of the Clarke-McNary law to have the location of such lands systematically determined by the Secretary of Agriculture, and if his findings are approved by the National Forest Reservation Commission to have the facts placed before Congress with a view to action. As already noted, certain additions were made during the year under this procedure. Detailed reports have been made upon a number of other desirable additions.

Several of these additions have been approved by the National Forest Reservation Commission, and the reports upon them have been transmitted to Congress by the President, in accordance with the provisions of section 8 of the Clarke-McNary law. In their present unprotected and undeveloped status these lands, which are too low in productivity to warrant private ownership and management, are rendering little if any service. They are valueless for farming purposes, and their unregulated use for grazing will, in many if not all cases, impair their forest and watershed values. At a time when the Nation is authorizing an enlarged program of forest-land purchases a course under which lands now in national ownership and valuable for timber production or stabilization of stream flow are allowed to remain unprotected, undeveloped, and neglected is difficult of understanding. To the fullest extent practicable such

lands should be made parts of the national-forest system, and nothing of substantial benefit is obtained by delay in accomplishing this.

LAND ACQUISITION THROUGH EXCHANGE

During the year an agreement was reached for selection by the State of California of a compact body of national-forest timbered land in exchange for the State's scattered holdings in the forests. No progress was made in the contemplated exchange with Colorado. The proposed exchange with New Mexico was delayed pending the enactment of a necessary State constitutional amendment. Satisfactory progress was made with the exchanges whereby Michigan, Montana, Oregon, and Washington will obtain solid blocks of Federal lands in place of their scattered holdings within the forests.

New legislation extended the provisions of the general exchange law to Spanish and Mexican land grants partly within or adjacent to the Carson, Manzano, and Santa Fe Forests in New Mexico, and also to private lands within 6 miles of the boundaries of the Crater in Oregon. Congress likewise authorized the exchange of public land outside the Manti in Utah for 640 acres adjoining that forest.

During the calendar year 1927, 135,678 acres of private lands within the national forests were obtained under the general exchange law in return for 7,447 acres of national-forest land and \$420,311 worth of national-forest stumpage, making a net addition to the forests of 128,231 acres. The Secretary of Agriculture approved and referred to the Secretary of the Interior for further action 155 new cases looking to the acquisition of 133,595 acres in exchange for 65,095 acres and 80,146,000 board-feet of stumpage. Since the law was passed 252 exchanges have been consummated and 371,217 acres have been acquired in return for 106,745 acres of national-forest land and \$748,307 worth of national-forest stumpage granted—a net addition of 264,472 acres. Much of the acquired land bears mature timber which eventually will be sold and removed under national-forest regulations, largely offsetting the initial grants of stumpage.

As was said last year, to safeguard against too great a use of national-forest resources for exchanges the Forest Service limits the value of the stumpage to be thus used to 10 per cent of the gross receipts in any State during a single year, and ordinarily

to 10 per cent of the timber-sale receipts alone. In the majority of the Western States the land offered now equals or exceeds what this limit allows to be immediately required. There will be an increasing opportunity to add desirable private lands.

Although a good beginning has been made in national-forest consolidation through land exchanges, there still remain within the forests almost 25,000,000 acres of land not in Federal ownership. These lands are interspersed among the national-forests, frequently forming parts of natural logging units or working circles which for efficient protection and management should be under a single control. It is believed that between 12,000,000 and 14,000,000 acres of this land should eventually be restored to Federal ownership and that the Forest Service should systematically acquire such lands as fast as the owners are willing to reconvey them and national-forest land stumpage is available for exchange. Their acquisition will permit of much more effective forms of forest management, will diminish present costs of protection and administration, and will facilitate the utilization of timber by purchasers.

There are also numerous fringes of land chiefly valuable for forest purposes, outside of but contiguous to the national forests. Because of their private ownership these lands were left outside when the forest boundaries were established, but they form integral parts of natural units of timber management and should be handled with the forests. Further legislation providing for their acquisition through exchange is therefore desirable.

Limited extensions of the exchange authority made by Congress for the Deschutes, Harney, Black Hills, and Crater National Forests and for the Spanish and Mexican land grants contiguous to national forests in New Mexico promise marked enhancement of the public value of these properties as permanent sources of timber supply. A bill extending the provisions of the land exchange law to lands within 6 miles of the national forests in Montana was passed by the Senate last spring, while another bill extending the provisions of the exchange law to lands within 3 miles of the east and west boundaries and 12 miles of the south boundary of the Olympic National Forest in Washington was passed by the House. The lands which would be affected by such legislation are relatively narrow strips between the forest boundaries and the desirable limits of forest growth

Since they do not in themselves form practicable units of forest management, the removal of the mature timber will unquestionably be followed in most cases by the discontinuance of private protection, and, unless they are added to the national forests, by eventual soil deterioration. Under proper care these lands would remain permanently productive, but if left in a depleted, slash-covered, and unprotected condition they must be not merely useless but a constant menace to the contiguous national forest.

LAND ACQUISITION THROUGH PURCHASE

Title was taken under the Weeks law to 242,121 acres, at a cost of \$1,766,628.84. The average cost per acre, \$7.30, exceeds by \$2.37 the previous average of all years.

Authorized purchases by the National Forest Reservation Commission totaled 261,107 acres and obligated \$1,996,358.04, or \$7.65 per acre. This high average was due primarily to the purchase of the so-called Waterville tract of 23,123 acres in the White Mountains of New Hampshire. The present heavy stand of very valuable timber on this land will in large measure ultimately be sold again, to be cut under provisions adequately safeguarding the exceptional scenic and recreational values involved. The area embraces Mad River Notch and the Greeley Ponds and has one of the few remaining bodies of virgin spruce in New England.

The distribution by States of the lands fully acquired is shown in Table 6.

TABLE 6.—*Acreage of timberland acquired in the fiscal year 1928 and total acquired to July 1, 1928, by States*

State	Acquired in 1928	Average price per acre, 1928	Total acquired to July 1, 1928
	<i>Acres</i>		<i>Acres</i>
Alabama.....	2,236	\$4.99	91,876
Arkansas.....	41,690	2.91	119,378
Georgia.....	5,791	4.54	200,736
Maine.....	874	14.92	33,130
Michigan.....	52,123	1.01	52,123
Minnesota.....	4,093	1.64	4,093
New Hampshire.....	23,565	42.69	450,890
North Carolina.....	5,135	3.08	369,649
Pennsylvania.....	37,062	5.11	251,568
South Carolina.....	1,069	4.24	42,111
Tennessee.....	43,619	4.84	366,409
Virginia.....	12,697	4.26	586,982
West Virginia.....	12,167	4.41	237,495
Total or average.	242,121	7.30	2,806,440

The total purchase cost of lands fully acquired—that is, not including overhead—has been \$14,414,423.93 and the average cost \$5.14 per acre.

The original objective of the Weeks law program was the acquisition of 1,000,000 acres of forest land in the White Mountains and 5,000,000 acres in the southern Appalachians. After 17 years this objective is a little less than one-half attained. In the meantime changes have occurred which make the original objective obviously insufficient. This has been recognized by Congress in the enactment of the Clarke-McNary and Woodruff-McNary Acts.

In the 1926 Report of the Forester a purchase program was outlined which proposed the acquisition of 4,000,000 acres more to complete the Weeks law forests and of approximately 2,500,000 acres in the Lake States and 2,500,000 in the southern pine States, in response to the broadened objectives set up by the Clarke-McNary law. After further study the Forest Service has formulated and the National Forest Reservation Commission has approved a revised and more specific program. It adds to the proposals set forth above the purchase of 600,000 acres in parts of the East where forest and watershed protection is urgently needed, but where no national forest now exists. Particular consideration will be given to the desirability of purchase units in Kentucky and Vermont to meet this need.

While regionally the contemplated purchases conform with the above totals, the revised program recasts the statement in new specifications, which in substance are as follows: (1) For the consolidation of national forests heretofore approved by the National Forest Reservation Commission and situated on the headwaters of navigable streams, 4,000,000 acres; (2) for the establishment of new forests necessary for the protection of headwaters of navigable streams and the reduction of floods thereon, approximately 2,000,000 acres; (3) for the consolidation of national-forest units on watersheds of navigable streams in Michigan and Minnesota, already approved by the commission, primarily to aid in timber production and to demonstrate forestry practice, approximately 1,100,000 acres; and (4) for the creation of new forests in the southern pine region and northern Lake States, primarily to aid in timber production and to demonstrate forestry practice, approximately 2,500,000 acres; total, 9,600,000 acres. This program is exclusive of

areas which, through the present study of the Mississippi flood situation, may prove to be desirable features of a flood-control program on that drainage basin.

Approval of the program was with three conditions: (1) Each new purchase unit to be subject to the enactment of enabling legislation by the State and to the concurrence of the State forest conservation agencies; (2) each new purchase unit to be specifically approved by the National Forest Conservation Commission; and (3) the maximum acreage to be purchased in any State, except for purposes of watershed protection or flood prevention, not to exceed 1,000,000 acres. These conditions amply guarantee proper coordination of Federal purchases with the plans of States and other agencies. As plans take definite form they are being submitted to the State forest conservation agencies for prior comment and concurrence, and no purchase area will be recommended which does not have the full approval of the proper State agencies.

In pursuance of this program, seven new purchase units have been submitted to and approved by the commission, and examinations are now in progress looking to the recommendation of additional units.

Two of the new purchase areas are in Michigan—the Marquette and the Mackinac. The former includes the Marquette division of the Michigan National Forest and contains 250,000 acres to be purchased, with 28,540 acres already owned by the United States. In the Mackinac unit 150,000 acres are to be purchased, while about 2,560 acres are unappropriated public land. The other five new purchase units are in the southern pine region—the Kisatchie, Catahoula, and Vernon units, each containing 50,000 acres, in Louisiana, and the Black River unit of 75,000 acres and the Wambaw of 100,000 acres in eastern South Carolina.

Changes were made in the boundaries of several of the old purchase areas, which do not necessarily coincide with the proclaimed national-forest boundaries and can be modified by the National Forest Reservation Commission without action by the President. To exclude lands more valuable for agriculture than forestry, or lands under effective private forest management, 24,851 acres were eliminated from the Cherokee unit in Tennessee and North Carolina; 116,565 acres from the Georgia unit in Georgia; and 37,972 acres from the

Natural Bridge unit in Virginia. The Ozark and Ouachita units in Arkansas were increased by 122,489 acres and 97,920 acres, respectively.

The present purchase areas contain approximately 12,239,796 acres. They include 1,914,491 acres of public domain, 11,369 acres transferred from the Treasury Department under a special act, and 3,140,938 acres acquired or in process of acquisition under the Weeks law. Of the remaining 7,172,998 acres 877,500 acres are known to possess agricultural, mineral, or water-power value which preclude purchase. The net unacquired forest land in the existing purchase units is therefore 6,295,498 acres. Some of it is held at prohibitive prices by owners, and some of it is already receiving such care and protection that there is no strong reason for public ownership. Approximately 210,000 acres are now under stable private management.

SPECIAL USES

At the close of the calendar year 1927, 32,430 special-use permits were in effect, of which 15,307 were free and 17,123 involved an annual rental charge. The receipts were \$285,684.12 mainly for hotel, resort, and private cottage sites. The pay permits increased by 216 and the free permits by 483. Most of the free permits were granted to facilitate the use of other forest land or resources.

Favorable reports were made on 18 and unfavorable on 68 homestead claims, most of them for lands listed under the act of June 11, 1906. The unfavorable reports were usually because the entryman had failed to meet the requirements of the law respecting residence and cultivation.

Applications for listing new land under the act of June 11, 1906, were for the most part rejected because the lands had already been classified as not chiefly valuable for agriculture. Applicants believing that the classification is erroneous may present for further consideration any facts tending to support the conclusion that the land has a real and permanent value for farming.

Favorable reports were made on 15 and unfavorable on 61 mineral cases. Attempts continue to misuse the mineral land laws in order to get control of forest lands for purposes other than mineral development. It is not difficult in many places to find slight traces of minerals, on the basis of which claims are often located in order that the locator may control the sur-

face, sometimes to use for his own benefit and sometimes to hold up some other legitimate uses of national-forest lands. The trouble became so acute in southern California that the citizens of that region urged legislation which would withdraw from mineral location considerable areas within the Angeles National Forest. An act providing for these withdrawals became a law on May 29, 1928. It, however, gives the President, on the joint recommendation of the Secretary of the Interior and the Secretary of Agriculture, power to restore to mineral location lands so withdrawn which on further examination may be shown to be valuable for their mineral deposits.

COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

The coordinating committee on national parks and national forests rescinded its tentative approval of the proposed adjustment of the western boundary of the Yosemite National Park. The subject was referred back to the Forest Service and Park Service for further consideration.

NORTHERN PACIFIC LAND-GRANT HEARINGS

As indicated by the Forester's annual report for the fiscal year ending June 30, 1927, the Attorney General of the United States was directed, by joint resolution dated March 3, 1927, to advise Congress "as to what legal or legislative action should, in his judgment, be taken in the matter of the adjustment of the said Northern Pacific land grants."

Following an exhaustive review of the record of the hearings as presented to the joint committee of Congress, the Attorney General, under letter of February 6, 1928, transmitted to the joint committee an opinion in which it was held that—

not only does no deficiency exist in the grants, but that the company [the Northern Pacific] has already received approximately 5,000,000 acres of public land which it has not earned and is not entitled to, besides additional values.

The opinion concludes that the United States has the right to repeal the granting acts or to declare them forfeited. This opinion sustains the position of the Forest Service that the Northern Pacific Railway Co. is not entitled to take upwards of 2,000,000 acres of national-forest lands in satisfaction of the land grants made by Congress to aid in the construction of the railroad.

Upon receipt of the opinion the joint committee requested the Attorney General to draft a bill embodying the legislation he thought Congress should enact. The bill was not submitted before Congress adjourned. By joint resolution approved May 26, 1928, Congress extended from June 1, 1928, to June 30, 1929, the direction that the Secretary of the Interior withhold the issuance of patents under the Northern Pacific land grants.

PROTECTION FROM FIRE

The number, size, and causes of fires on the national forests in the calendar year 1927, as compared with those of the previous year and the average of the past 5-year period, are shown in Table 7.

TABLE 7.—Comparison of fires on national forests, calendar years 1927, 1926, and 5-year average for period 1923-1927

Classes and causes of fires	Number of fires			Percentage of total		
	1927	1926	Average, 1923-1927	1927	1926	Average, 1923-1927
Class:						
Burns of 0.25 acre or less.....	3,588	3,590	3,596	63.02	50.60	52.17
Burns between 0.25 and 10 acres.....	1,443	2,042	1,906	25.35	28.78	27.65
Burns of 10 acres and over.....	662	1,463	1,391	11.63	20.62	20.18
Total.....	5,693	7,095	6,893	100.00	100.00	100.00
Cause:						
Railroads.....	297	390	318	5.22	5.50	4.61
Lightning.....	3,074	3,387	3,387	54.00	47.74	49.14
Incendiarism.....	397	661	807	6.97	9.31	11.71
Brush burning.....	163	255	226	2.86	3.59	3.28
Lumbering.....	77	119	141	1.35	1.68	2.05
Camp fires.....	596	672	669	10.47	9.47	9.70
Smokers.....	875	1,282	1,082	15.37	18.07	15.70
Miscellaneous.....	214	329	263	3.76	4.64	3.81
Total.....	5,693	7,095	6,893	100.00	100.00	100.00

TABLE 7.—*Comparison of fires on national forests, calendar years 1927, 1926, and 5-year average for period 1923-1927—Continued*

Calendar year	Total area of national-forest land burned over	Total damage of national-forest land burned over	Total cost fighting fires exclusive of time of forest officers
1927.....	<i>Acres</i> 170, 473	\$298, 733	\$646, 624
1926.....	776, 570	4, 563, 081	2, 167, 732
5-year average, 1923-1927.....	412, 807	1, 465, 462	1, 106, 252

The 1927 showing compares favorably at practically every point with that for 1926 and with the 5-year average. Two outstanding points may be noted: In 1927 the number of man-caused fires was 29 per cent below the number in 1926 and 25 per cent below the 5-year average, and the area of national-forest land burned over was 78 per cent below the area burned over in 1926 and 59 per cent below the 5-year average.

This drop was due to three causes. On the whole the season was favorable—though the number of lightning fires in 1927 was close to the average. Secondly, the executive management of fire-control activities has improved with accumulated experience, study, and insistent pressure for better performance all along the line. Thirdly, the funds available for fire guards, training, and equipment were increased.

The 1928 fire season to the close of the fiscal year and well through July gave promise of an unusually good record. This was primarily because of rains in the northern Rocky Mountains and northern Pacific States, which both shortened the period and materially lessened the severity of the customary summer drought. The rains, however, did not extend into California to any appreciable degree, and the season in that State was of much more than average severity.

While most of the acreage burned over lay outside the national forests and the fires on the forests were mainly kept out of the heavy timber, they taxed to the utmost the protective organization. As the season advanced the conditions grew worse, and at the date of this report the California district is carrying a peak load. The north Pacific district also has been confronted with a trying situation in August in consequence of a period of abnormally high temperature, wind, and low humidity.

Public interest in the control of forest fires is becoming greater and

greater, and nowhere is this more conspicuous than in California. Especially in southern California, but very markedly also throughout nearly all of the State, the interest in fire prevention is intense. In consequence the Forest Service is receiving a large amount of cooperation from counties, towns, organizations of various kinds, and individual corporations and citizens.

The press of the State has actively and effectively backed protection and has done much to build up a strong sense of the need for it and a public demand that fire control must be achieved. All over the country, indeed, the subject is of such general interest that forest fires which a few years ago would have gone unnoticed are now given a prominent place in the daily news; and this to some extent tends to give an exaggerated impression of the actual losses.

While the losses are far greater than they should be and the public demand for better protection is well based, enormous progress has been made in developing efficient methods of control. Every year brings improvement. The Forest Service has always considered protection of the national forests its first duty. It presents problems of great difficulty and requires the creation and application of highly specialized knowledge and skill, as well as a large provision of equipment and works of control. In the nature of things, an adequate protective system can be brought into existence only through assiduous study, long-continued effort, and many setbacks. Much remains to be learned, and much remains to be done before practice will be abreast of what has already been learned, but the protective system of to-day is markedly superior to that of even a few years ago.

Efficient protection includes measures that lessen the likelihood of fires; systematic plans and provisions beforehand for instant action of the right kind and necessary amount when the

need for action develops; means for swiftly spotting, correctly locating, and immediately reporting all fires that start; and as soon as the alarm is received, prompt, rapid, and sustained movement to subdue the outbreak. Personnel, organization, equipment, and knowledge of all that relates to the behavior and control of fire summarizes the principal requirements for efficient performance in these various activities. Each represents a definite field of effort for improvement on the part of the Forest Service. To the extent possible with present funds the personnel is being enlarged and given special training for fire work; the organization for that work is being searchingly studied and steadily improved; new equipment is being developed, tested, and introduced—for example, tractors and other power machinery for constructing fire lines, and enlarged use of pumps in fire fighting—and special fire studies are being prosecuted to obtain through research better means of control. The drive for strengthening the mechanism of protection and for better performance in fire control is always on and will continue to be pressed energetically in every direction that holds out a promise of worth-while results.

Mention was made in last year's report of the establishment, by the chief coordinator of the Bureau of the Budget, of a protection board comprising representatives of the four Federal bureaus having extensive areas of forest lands to administer—that is, the Forest Service, the National Park Service, the Bureau of Indian Affairs, and the General Land Office—and also of the Bureau of Biological Survey and the Weather Bureau. This board, enlarged to include also representatives of the Bureaus of Entomology and Plant Industry, now embraces in its field protection against insects and tree diseases as well as against fire. It is making distinct progress in strengthening the Federal provision for controlling fires on forest lands of the United States, through better coordination of the efforts of the bureaus administering such lands and through the interchange of ideas and information. The most important step of the year to this end was the creation of regional boards which bring together the field men having in charge the work of actual protection. Joint use of purchasing facilities and of training-camp instruction are examples of the opportunities taken advantage of. In general, the protection board has

become an agency of great potential usefulness.

When the weather is favorable to fire control, national-forest organizations have breathing spells in which to catch up on other work. Broadly speaking, both 1927 and 1928 were relatively favorable years. Consequently the construction of telephone lines and of such structures as cabins for fire guards and lookout men could be carried on when rains made it safe for men to leave for a few days at a time the posts they must occupy day and night if conditions are threatening. Opportunities of this sort are very welcome, for the insufficiency of improvements is one of the weakest points in national forest protection. A recently completed survey of the requirements for fire control showed 12,066 miles of telephone line urgently needed, including replacements. Of the present lookout towers 73 need replacing, and 205 new ones are required.

To discover fires while small is essential. The lookout men are the eyes of the fire organization. When mountain peaks command a satisfactory view they take the place of towers; but these peaks are often so windy and cold that without shelter men can not stay on them continuously. Many-windowed cabins placed where the view is best are therefore required. There are now 359 such lookout cabins; 314 more are critically needed.

Similarly, 76 dilapidated cabins for fire guards call for replacement, and 588 new cabins should be built in locations where fire guards are now uneconomically sheltered by tents or are unprovided for. Upon the proper placing of guards depends the promptness with which fires can be reached after they are discovered and reported by the lookout men. Barns for horses and mules employed in protection are needed to the number of 227 new ones and 20 replacements.

Fire breaks are an investment which pays good dividends in reduction of fire losses, and should be constructed in many places. A special appropriation provides for their construction in cooperation with local agencies in southern California, deeply concerned for the protection of the watersheds of that region because of its high value to them. It has been impossible to consider constructing fire breaks elsewhere, but a need for 301 miles at particularly critical locations has been definitely recognized.

Other requirements include storehouses for equipment and food, water development, simple sanitary facilities, and pastures. Cut to the minimum, the estimates of urgent needs for protection improvements total \$1,779,206, exclusive of developments needed at headquarter ranger stations and public camp grounds. In many cases the improvements of the latter kinds also are chiefly necessary in the interest of fire control. The total needs for improvement construction amount to \$2,969,387, exclusive of range and camp-ground improvements.

The need for range improvements is discussed elsewhere. The appropriation item for improvements (other than camp-ground improvements, which are covered by a special item) in the fiscal year 1928 was \$526,900, and for the fiscal year 1929 is \$587,900. An allotment of \$30,000 for each year to range improvements and deductions for certain local improvements specified in the appropriation act reduced the general fund to \$394,900 for 1928 and to \$421,900 for 1929. To maintain existing improvements now requires about \$322,000 annually.

On the other hand, the improvement funds are supplemented by the use of the time of guards and rangers whenever favorable fire conditions permit. Such contributed time in the fiscal year 1928 theoretically augmented the improvement funds by \$331,799. In results, however, the value of the contributed time was much less, since men employed primarily for fire duty but switched for a few days at a time to such improvement work as happens to be within reach are used at a decided disadvantage, from the standpoint solely of the improvement work.

Much more advantageous use could be made of contributed time if it were possible to have telephone wire, lumber, and other materials more commonly on hand. Efforts to plan closely for utilizing spare time of the protection force are often nullified for lack of money to purchase and transport such materials.

RADIO EXPERIMENTS UNDER WAY

Friends of forest protection often wonder why radio has not been utilized as a means of maintaining the communication so necessary for successful fire control. Shortly after the close of the World War the Forest Service experimented with the radio equipment then available. Those early tests were discouraging, but with

the need for communication so urgent further trial seemed obligatory.

Probably very little of the present 33,165 miles of Forest Service telephone line, constructed where other lines do not now exist, or of the over 7,000 miles of new line already scheduled as definitely needed, can ever be replaced by radio. It is true that there are some long lines in remote regions which, although vital to fire control for a period of two or three months each year, could nevertheless theoretically be replaced by radio communication with attractive economy in cost. The main reason for seeking to develop radio communication, however, is not to do away with existing or proposed telephone lines but to supplement them. Even the single-wire telephone lines normally used on the national forests cost from \$70 to \$90 per mile to construct. They can not be built as needed to keep constant touch with all the scattered and shifting crews of men at work building roads or on some other form of construction work deep in the forests during the fire season. Such crews must move their camps frequently as their work progresses. To a certain extent touch can be maintained with them by emergency lines of insulated small wire laid on the ground or hung on the limbs of trees but even this is expensive and often is not feasible.

It would be a great help if each such crew could be supplied with radio equipment weighing perhaps 50 or 60 pounds through which touch could always be maintained with the forest headquarters. It would also be a great help if a forest officer on reaching a fire could report back whether he needs a force of men to aid him, and if so, how many.

As a rule when fires must be fought by an organized crew of some size an emergency telephone line is laid from the nearest permanent telephone line to the fire. This, however, takes the time of men who are badly needed just then to prevent further spread of the fire. Since light radio equipment both sending and receiving, is already on the market, it would seem that there should be no difficulty in providing for such needs. But the matter is by no means simple. Aside from such technical matters as the best wavelength to use, the type of battery power which will give the greatest sending power with the lightest weight and the height, length arrangement and method of erecting antenna wires

to be set up for temporary use in the woods, there are difficulties due to the effect of topography on transmission of code and voice. Further, the transmission of radio energy is affected to an unknown extent by what is called absorption by trees.

When the Forest Service sought advice from technical authorities of the Federal Government on radio, it learned that no work has been done on which conclusions can be based as to whether radio transmission of code and voice is a practicable thing under the conditions obtaining on the national forests. It has become necessary therefore not to test radio apparatus in connection with fire control but to test the national forests for the use of radio. Experimental work is under way.

If this laborious task of determining the effect of topography and timber on communication by radio shows that with certain equipment and methods fairly reliable results can be obtained, the way is open to the use of this new scientific development as an important aid in forest protection. There is no expectation of developing radio equipment which will permit transmission of voice both ways between a permanent central station and moving camps in the woods. Doubtless communication from the woods to the permanent central station must be by telegraph, using some simplified code.

PROTECTION FROM INSECTS AND TREE DISEASES

Epidemics of tree-killing insects, especially bark beetles, are part of the history of all coniferous-forest regions, especially those in which the older trees have not yet been cut. The young timber and reproduction are seldom killed, but the death of the older and larger trees destroys in whole or in part the marketable timber and creates bad fire conditions. The loss of timber, both directly and indirectly, from insect epidemics is of serious proportions and public concern.

During the year the most serious insect epidemic conditions on the national forests were in Montana and California. In Montana an increasing epidemic in the lodgepole pine on the Beaverhead National Forest, scattered over about 100,000 acres, was fought to prevent the complete loss of the trees large enough to be used now for ties or mining timbers and to prevent the spread of the infestation toward the valuable stands on the national forests surrounding the Yellowstone National Park. The technical methods followed

in this work were those recommended by the Bureau of Entomology, which in this as in other projects gave its hearty cooperation. It is as yet too soon to determine the degree of success of the work, but it is known that the areas covered by the same methods in the spring of 1927 had a relatively light infestation in 1928. It will probably be necessary to continue to fight this epidemic for at least another year.

In California an outbreak of another species of bark beetle on the Modoc National Forest and on intermingled and surrounding patented lands has been extremely destructive. As much as half of the valuable old pine timber has been killed on some sections. As the year closed the national forest timber was being advertised for sale under a contract which requires the purchaser to log the infested trees on a total of 15,000 acres of private and United States lands before the beetles emerge in the spring of 1929. In this way it is hoped to check the infestation by the removal of large numbers of beetles in the logs and to salvage the infested trees before they deteriorate too greatly to make usable lumber.

An infestation in western yellow pine on a national forest in Colorado was fought for the second year. This epidemic appears to have been checked, and probably little, if any, work will have to be done on it in 1929. Relatively small projects in Arizona, Oregon, and western Montana, in each case in valuable timber, were also carried out, that in Oregon being in cooperation with the owners of intermingled and adjacent privately owned timberlands. An area close to the Crater Lake National Park was also worked over to supplement the efforts of the National Park Service in combatting an infestation chiefly within the park.

A steady drain on the timber resources of the national forests by insects in small infestations is very large in the aggregate but is apt to be overlooked in the attention necessarily given to the disastrous larger outbreaks. The finding and removal or treatment of small groups of infested trees is both a check on this drain and the best preventive of major outbreaks. In cooperation with the Bureau of Entomology the training of forest officers to recognize dangerous conditions and to take the necessary action is being pushed.

Disease control is a problem comparable in magnitude with that of insect control and presents even more

formidable aspects. The white-pine blister rust was found during the year for the first time in the national forests of northern Idaho. This disease passes part of its life on the leaves of currants and gooseberries. Where these alternate hosts are abundant the commercial growing of any species of the five-needled pines is impossible. If there are no currants or gooseberries within about 1,500 feet there is little danger of infection to the pines. The spread of the disease into the western white-pine region of northern Idaho and western Montana makes necessary immediate decision whether to abandon the growing of the most valuable timber tree of the region or to control the disease by destroying the wild currants and gooseberries which are common in the region. The Forest Service believes it to be sound public policy to take the latter course, using the technical methods for destroying the currants and gooseberries which have been developed by the experimental work of the Bureau of Plant Industry and adopting each improvement in those methods as it is found and tested. No other action would be consistent with the purpose of furnishing "a continuous supply of timber for the use and necessities of citizens of the United States."

About 1,500,000 acres of national-forest land in the western white-pine region will need protection against this disease. This includes only the areas on which white pine will be the most important tree in future crops of timber. A plan for destroying the wild currants in this area progressively during the next 20 years has been prepared. More rapid action may prove to be necessary. In either case the additional work can not be done with the resources now available.

Another imported disease, the chestnut blight, continues to spread in the national forests of the Appalachians. No effective means of combating this disease under forest conditions is known. It is not dependent on an alternate host, as is the white-pine blister rust. Excellent progress has been made in salvaging the chestnut of usable size on the national forests. On the Natural Bridge Forest most of the chestnut suitable for telephone poles, the most valuable form of product, has been sold and cut. Although the ground formerly occupied by chestnut will be covered by other species, especially oaks, the elimination of chestnut will reduce the rate of

growth in volume per acre materially, and will force the closing of industries, such as some tannic-acid manufacturing, which have used its wood.

Larch canker, a new disease recently introduced into the United States by importation and similar in many ways to the chestnut blight, threatens if once firmly established to become by far the most serious source of forest destruction ever known in this country since it kills not only larch but Douglas fir and, perhaps, western yellow pine. The stake is stupendous, and the most energetic measures of control should be inaugurated. The Forest Service views the situation with the utmost anxiety.

Old timber of any species is subject to attack by native rots or other diseases. The common occurrence of rot in old stands of pine or Douglas fir is an example. The cutting of diseased trees is required by the contract for the sale of national-forest timber as a precaution against the spread of infection to the new crop. The effect is becoming evident with the increasing period of national-forest administration. In the Black Hills region of South Dakota, for example, the reduction of the log scale, to allow for rot in the second cutting will be less than half of that in the first cutting. The aim is to grow stands of timber free from diseases which either kill the trees or reduce their usefulness, and the steady, gradual elimination of sources of infection is necessary for the accomplishment of that purpose.

TIMBER

The timber resources of the national forests must be handled under the best forestry methods consistent with present economic conditions, if they are to fit into their right place in the general timber economy of the United States. The national forests make the Federal Government far and away the largest timberland owner in the country. It should take the leadership in efficient forest management.

One of the basic purposes of the national forests as defined by Congress is "to furnish a continuous supply of timber for the use and necessities of citizens of the United States." Yet there is another important purpose for them to serve. They should, through sound forestry practice, demonstrate to the private owner the possibilities of management. Upon them silvicultural practices and sound principles of forest management can and should be developed on a scale large enough to

be practically applicable by the owners of extensive private tracts. They have therefore the dual rôle of producing timber to supply present and future needs, and of developing and demonstrating the best methods of forest management.

Some have maintained that the national-forest timber should be held for the future and no cutting should be allowed at the present time. Such a policy would be short-sighted. Obviously, in that case the national forests could not play any considerable part in the development of forestry in the United States. And besides, timber can not be stored indefinitely. Decay and the ravages of timber-destroying insects are sure to deplete mature and overmature stands. Virgin forests ordinarily do not increase in volume, since the natural loss balances growth. The mature stands which cover the larger portion of the national forests are in very many places not even holding their own but are actually going backwards. The remedy is systematic cutting so that new growth can start.

Yet this cutting must be so regulated as to assure a continuous supply. To harvest these virgin stands as fast as possible would in the long run produce more timber, but it would result in a suspension of cutting after the present supplies are gone until a new growth is large enough to be marketed. The cutting must therefore be extended over a long period. This enables the forests not only to yield for present consumption timber which otherwise would be largely wasted through decay but also to increase steadily their production through growth without interrupting their future yield at a time when it will be badly needed.

The cut of national-forest timber, although only about one-sixth of what it may be ultimately, has increased from 138,666,000 board-feet in 1906 to over 1,000,000,000 feet annually. The rate of increase could easily have been accelerated by offering timber without regard for the permanency of local industries and by offering timber at bargain rates. Neither has been done. The purpose has been and is to offer timber at fair appraised prices as the needs of users and the development of transportation make successive units of the forests ready for operations, and then to sell no more than can be supplied in the future as the timber is renewed by growth. At the present time less than

3 per cent of the lumber consumed annually in the United States is derived from national-forest stumpage.

To make the national forests of greatest value for the present and future timber supply of the United States they have been studied for many years. As opportunity arises they are being organized into a large number of timber farms, each managed under definite plans for permanent wood production. This involves also the stability of the industries manufacturing the timber and of the communities dependent on those industries.

Plans for the management of these timber farms are made as they are needed to guide operations on parts of the forests where transportation facilities make the cutting and removal of timber feasible. They give definite answers to such questions as what shall be the area unit from which a "continuous supply of timber" is to be obtained; how much timber can be cut from that area annually or by decades and still have the growth on the whole unit replace the amount cut; what conditions must govern the cutting in order to obtain the best crops of timber for future cutting; what bodies of overripe or deteriorating timber need cutting promptly; how the greatest aid can be given to local industrial and community stability through the provision of employment in woods work and of raw material for the manufacture of forest products; and, finally, what definite areas of timber are to be offered for sale during the next 10 or 20 years.

Under such plans the future availability of definite quantities of timber is assured, and business enterprises can depend upon it. Further, the administration of each area can be organized on a permanent basis, since the amount of timber to be cut during each year or other period is known. On the Harney National Forest in South Dakota, for example, the cutting and manufacturing of timber is the chief business of several small towns, each of which knows that the timber tributary to it is being cut no faster than it is being replaced, and therefore that it need not fear the fate of most sawmill towns of the past. Only some major disaster, such as a series of large forest fires or a great epidemic of tree-killing insects, will imperil the continuous output of timber from a national forest thoroughly organized under sound timber-management plans.

The preparation of these plans must be preceded by an inventory of the timber on the area and by studies of the growth rate of young timber stands in the region. Steady progress is being made in all the national-forest regions in getting these data and in making plans based on them. During the year about 30 plans in either preliminary or final form were prepared and approved by the Forester. A bulletin describing the preparation of timber-management plans and containing the text of four previously approved plans was published. The preparation of management plans for additional national-forest areas as they are needed and the systematic review and modification of existing plans as better data are obtained and as market or other conditions change, will be a continuing task through future years.

Timber sales are made in accordance with the provisions of these plans. The limiting of the output to the quantity that can be sustained not only leads to stability and permanence of industries and communities but also tends to prevent the overproduction of lumber and other products. The lumber industry has tended to be concentrated in regions or localities, each of which is stripped of its usable timber in turn. To an increasing extent, the

example of continuous yield from the national forests is inducing lumbermen to study their own holdings to see if they can not be managed on the same basis; sometimes in connection with adjacent national-forest areas. Thus the national forests are fulfilling their objects both as timber-producing unit and as demonstration areas for the production of timber in private ownership.

The cut and sales of national-forest timber in the calendar year 1927 are shown in Tables 8 to 10. During the year the lumber industry was suffering one of its periodic depressions. Many lumbermen shut down or operated only on a reduced scale. Such conditions are inevitably reflected in the cut of national-forest stumpage; and the volume fell off as compared with that in 1926. A following partial recovery in the lumber industry has brought up the cut for the fiscal year 1928 to practically the same as that for the fiscal year 1927; and the receipts from timber were actually greater by \$71,836.74, totaling \$3,325,079.24 during the fiscal year 1928. The sales business now assured makes it clear that the check in the growth of use of the timber resource was temporary, as were similar checks in previous times of depression such as 1915 and 1921.

TABLE 8.—Quantity and value of national-forest timber sold, calendar year 1927

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	Board feet	Board feet	Board feet			
Alabama.....	201,000		201,000	\$423		\$423
Alaska.....	37,134,000		37,134,000	55,484		55,484
Arizona.....	11,960,000	356,000	12,316,000	23,672	\$352	24,024
Arkansas.....	4,944,000	232,000	5,176,000	31,681	232	31,913
California.....	67,952,000	1,538,000	69,490,000	172,088	1,030	173,118
Colorado.....	42,372,000	911,000	43,283,000	104,747	838	105,585
Florida.....	3,038,000		3,038,000	16,894		16,894
Idaho.....	62,547,000	4,420,000	66,967,000	150,361	4,088	154,449
Kentucky.....	23,000		23,000	268		268
Michigan.....	4,806,000		4,806,000	9,027		9,027
Minnesota.....	4,233,000		4,233,000	19,426		19,426
Montana.....	22,381,000	2,959,000	25,340,000	45,017	3,157	48,174
Nevada.....	1,222,000	233,000	1,455,000	1,339	191	1,530
New Hampshire.....	12,136,000		12,136,000	65,270		65,270
New Mexico.....	20,726,000	684,000	21,410,000	49,357	604	49,961
North Carolina.....	14,683,000		14,683,000	27,806		27,806
Oregon.....	36,105,000	2,434,000	38,539,000	103,878	1,684	105,562
Pennsylvania.....	143,000		143,000	964		964
South Dakota.....	29,059,000	358,000	29,417,000	99,918	395	100,313
Tennessee.....	14,250,000	101,000	14,351,000	17,285	115	17,400
Utah.....	3,997,000	999,000	4,996,000	7,423	1,064	8,487
Virginia.....	34,679,000	1,000	34,680,000	101,631	2	101,633
Washington.....	158,805,000	274,000	159,079,000	349,975	165	350,140
West Virginia.....	800,000	4,000	804,000	1,948	4	1,952
Wyoming.....	37,979,000	1,019,000	38,998,000	106,500	964	107,464
Total, 1927.....	626,175,000	16,523,000	642,698,000	1,562,382	14,885	1,577,267
Total, 1926.....	1,471,191,000	18,181,000	1,489,372,000	4,062,387	16,525	4,078,912

¹ In addition, minor products not convertible into board feet were sold, value \$59,368.

² In addition, minor products not convertible into board feet were sold, value \$19,655.

TABLE 9.—Quantity and value of national-forest timber cut under sales, calendar year 1927

State	Quantity cut			Value		
	Commer- cial sales	Cost sales	Total	Commer- cial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>			
Alabama.....	227,000	-----	227,000	\$458	-----	\$458
Alaska.....	55,293,000	-----	55,293,000	92,471	-----	92,471
Arizona.....	67,661,000	337,000	67,998,000	182,991	\$363	183,354
Arkansas.....	6,119,000	233,000	6,352,000	39,274	233	39,507
California.....	272,922,000	1,615,000	274,537,000	332,189	1,045	833,234
Colorado.....	35,917,000	539,000	36,456,000	99,649	568	100,217
Florida.....	1,963,000	-----	1,963,000	9,208	-----	9,208
Idaho.....	119,245,000	4,584,000	123,829,000	439,600	4,205	443,805
Kentucky.....	8,000	-----	8,000	79	-----	79
Michigan.....	2,077,000	-----	2,077,000	3,494	-----	3,494
Minnesota.....	10,454,000	-----	10,454,000	45,847	-----	45,847
Montana.....	21,653,000	3,102,000	24,755,000	44,165	3,196	47,361
Nevada.....	956,000	186,000	1,142,000	1,239	185	1,424
New Hampshire.....	5,705,000	-----	5,705,000	28,347	-----	28,347
New Mexico.....	13,310,000	679,000	13,989,000	31,287	532	31,819
North Carolina.....	11,056,000	-----	11,056,000	31,027	-----	31,027
Oregon.....	167,524,000	2,241,000	169,765,000	461,254	1,434	462,688
Pennsylvania.....	120,000	-----	120,000	894	-----	894
South Dakota.....	23,075,000	372,000	23,447,000	80,316	445	80,761
Tennessee.....	12,338,000	74,000	12,412,000	17,423	82	17,505
Utah.....	5,216,000	976,000	6,192,000	9,530	952	10,482
Virginia.....	11,807,000	2,000	11,809,000	30,952	4	30,956
Washington.....	201,334,000	195,000	201,529,000	415,656	113	415,769
West Virginia.....	392,000	4,000	396,000	1,485	4	1,489
Wyoming.....	29,061,000	1,049,000	30,110,000	70,361	916	71,277
Total, 1927.....	1,075,433,000	16,188,000	1,091,621,000	2,969,196	14,277	¹ 2,983,473
Total, 1926.....	1,158,450,000	16,823,000	1,175,273,000	3,441,137	15,024	² 3,456,161

¹ In addition, minor products not convertible into board feet were cut, value \$8,484.² In addition, minor products not convertible into board feet were cut, value \$9,526.

TABLE 10.—Number of national-forest timber sales classified according to amounts of sale, calendar year 1927

State	\$500 or under, com- mercial sales	\$500 or under, cost sales	Total	\$501 to \$1,000	\$1,001 to \$5,000	Over \$5,000	Total
Alabama.....	39	-----	39	-----	-----	-----	39
Alaska.....	196	-----	196	16	8	2	222
Arizona.....	922	219	1,141	2	5	-----	1,148
Arkansas.....	66	95	161	-----	-----	2	163
California.....	443	318	761	2	10	9	782
Colorado.....	579	146	725	7	11	5	748
Florida.....	97	-----	97	-----	-----	1	98
Idaho.....	870	1,364	2,234	3	14	6	2,257
Kentucky.....	12	-----	12	-----	-----	-----	12
Michigan.....	48	-----	48	-----	2	-----	50
Minnesota.....	148	-----	148	-----	2	1	151
Montana.....	616	859	1,475	7	4	-----	1,486
Nevada.....	99	97	196	-----	-----	-----	196
New Hampshire.....	157	-----	157	7	5	2	171
New Mexico.....	810	379	1,189	4	12	-----	1,205
North Carolina.....	290	-----	290	1	3	-----	294
Oregon.....	416	471	887	1	3	8	899
Pennsylvania.....	7	-----	7	-----	-----	-----	7
South Dakota.....	261	76	337	2	9	5	353
Tennessee.....	270	69	341	3	3	-----	347
Utah.....	232	599	829	-----	-----	-----	829
Virginia.....	420	1	421	-----	3	1	425
Washington.....	176	60	236	2	10	6	254
West Virginia.....	10	3	13	-----	-----	-----	13
Wyoming.....	278	214	492	3	1	3	499
Total, 1927.....	7,462	4,970	12,432	60	105	51	12,648
Total, 1926.....	7,528	5,369	12,897	135	109	58	13,199

PLANTING

Planting is a necessary step in keeping forest land productive wherever past fires or other destructive agencies have denuded the land to such an extent that the timber will not reproduce naturally. The national forests include over 2,100,000 acres which should be growing timber but are not doing so. The planting of forests on them represents an urgently needed addition to the future timber supply of the Nation. Before it could be undertaken in any region on an adequate scale, careful tests and experiments in the production of small trees in nurseries and in planting methods had to be carried out, and the most effective and economical forms of organization of the work had to be devised and tested. In a number of regions, particularly in the western white-pine region of northern Idaho and western Montana, in the Lake States, in the sand hills of Nebraska, in the mountains of Colorado, in the Douglas fir region of western Washington and Oregon, and recently in the northern Appalachian Mountains, the technic of planting has been worked out. A beginning of the same process has been made in California.

Hitherto it has been possible to plant only from 7,000 to 12,000 acres annually. For economy the work has been concentrated in a few places; on other projects of almost equal urgency nothing has been done.

On the Michigan National Forest planting costs only about \$4 per acre—less than on any other forest. This low cost is due to the methods developed by careful study and tests of the local soils, species, and climatic conditions. The work has been done almost exclusively on the portion of the national forest in the Lower Peninsula, where about 20,000 acres have been planted and about 5,000 acres is added annually. On the portion of the forest in the Upper Peninsula, where the need is almost as great, it has been possible to plant only a few hundred acres.

An increase in the appropriation for planting from \$131,700 for the fiscal year 1927 to \$150,000 for the fiscal year 1928 made possible the starting of planting work on more than an experimental scale in the Appalachian region. A nursery has been established on the Monongahela Forest in West Virginia, and when the trees grown in it are ready for planting about 1,000 acres of the denuded burns on that forest will be reforested an-

nually. Small increases in the scale of planting in the Lake States were also made possible. The further increase in funds for the fiscal year 1929 will enable work to be undertaken on important projects on municipal watersheds in Colorado and Wyoming, on highly productive pine-land burns in California, and on several small projects in the eastern forests. An increase in the scale of work in the Lake States is also planned. Further increases in the scale of planting are needed to get progress commensurate with the size of the job and to bring the work into balance with other activities in national forest administration.

National-forest planting is done chiefly in the spring. Table 11, which gives the acreage planted in the calendar year 1927, does not, therefore, show the full effect of the increased appropriations for the fiscal year 1928, nor will that full effect appear until the new and enlarged nurseries have grown the additional numbers of small trees to a size suitable for field planting. The total of 12,847 acres planted or sown is, however, larger than in any other year of the past decade.

TABLE 11.—Planting and sowing on national forests by States, calendar year 1927

State	Area planted	Area sown	Total
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Michigan.....	4,293.25	-----	4,293.2
Idaho.....	3,376.00	-----	3,376.0
Washington.....	1,310.00	-----	1,310.0
Colorado.....	1,251.69	-----	1,251.6
Nebraska.....	971.10	-----	971.1
Minnesota.....	545.00	-----	545.0
Oregon.....	510.00	-----	510.0
Montana.....	296.00	-----	296.0
West Virginia.....	152.15	-----	152.1
North Carolina.....	68.00	-----	68.0
Tennessee.....	.33	31.75	32.0
Kentucky.....	7.75	10.80	18.5
California.....	16.12	-----	16.1
Virginia.....	3.73	.82	4.5
Wyoming.....	2.12	-----	2.1
Total.....	12,803.24	43.37	12,846.6

RANGE

The western range livestock industry of to-day is very different from that of a quarter of a century ago. Unquestionably the changes that have taken place have been along economic lines. The new ways mean far better land use, more money for the stockmen, and more and better livestock products for the consumer. It is safe to say that even without the national

forests the general trend would have been in the same direction. But it would have been far slower, more irregular and uncertain, and at the cost of bitter struggles within the industry, with much individual and community suffering and loss.

RELATION OF NATIONAL-FOREST RANGES TO COMMUNITY WELFARE

At the opening of the twentieth century livestock production in the West was typically a public-lands industry. It had grown great on free range. It was a temporary use of vacant lands, pending the arrival of claimants entitled to make entry. It had already surrendered to the homesteader much of the country over which it had earlier held undisputed sway. This as well as its own growth had created fierce competition for use of the range, resulting in "range wars" and in overgrazing—which, of course, made matters still worse for the stockmen. The whole situation was precarious, chaotic, transitional, and in many ways economically unsound. It was also one which tended to retard rather than to facilitate settlement and community development.

To protect themselves many of the more powerful stockmen sought ways to establish range monopoly. On the other hand, nomadic flocks and herds from distant wintering and breeding grounds increasingly swept the high ranges. The "tramp stockman" moved from one region to another, pressing in ahead of the local residents in a scramble to get the feed. The home maker was ground between the upper and the nether millstone. To raise stock—the only product oftentimes which he could get to market—he had to have summer pasturage in the mountains; but there he found the feed eaten out. Very likely before he was prepared to begin the move the invading herds had come almost to his door. He was fortunate if his fences had sufficed to hold them out of his own meadows.

To-day, within or adjacent to almost every national-forest ranger district from Canada on the north to Mexico on the south, may be found thriving agricultural communities whose prosperity is mainly dependent upon the stable production of livestock. Climate, soil, and location combine to make this the most profitable form of agriculture. In many if not most cases, indeed, it is the only practicable form. Original settlement was greatly

influenced if not wholly induced by the extensive areas of nutritive native grasses adjoining the more productive valley lands.

The latter make possible developed ranches that serve as headquarters. Here in early days ample native hay could be harvested to supply winter needs, while abundant supplemental free range near by provided the means for a year-round economical livestock operation.

Overstocking of the range lands eventually taxed the agricultural valleys to the utmost to supply a deficiency in feed. This led to more intensive ranch management. Additional areas of agricultural land were broken up and seeded to more nutritious introduced species of grasses. There was a limit to which this could be done, and the further depletion of all range lands through the introduction of transient stock materially curtailed the number of stock operated from the valleys. Ranch incomes were greatly reduced, and the future of many once-productive ranches was most problematical. The fruit of years of labor and privation of pioneering settlers was at stake.

Unheralded, national-forest range administration sprang out of this chaos. The policy laid down by Secretary of Agriculture James Wilson on February 1, 1905, when he directed the Forest Service to "see to it that the water, wood, and forage of the reserves are conserved and wisely used for the benefit of the home builder first of all, upon whom depends the best permanent use of lands and resources alike," was a gleam of hope in an otherwise black foreground. That the policy has been carried out is attested by the present thriving condition of these mountain communities.

Natural conditions, of course, have played their part. An abundance of water for irrigation, an ample supply of timber for wood and building purposes, with the native grasses and other forage plants ripening at different altitudes to meet seasonal needs of ranch lands and livestock, awaited only the protection which national-forest administration has afforded. The point is that range regulation governed by economically sound principles and based on the authority of the Government as owner of the land to prescribe how it shall be used, together with the development by the Government of the technical knowledge essential for a right handling of the range resource, has made it possible to promote con-

ditions of community welfare that, in the absence of regulation, could have been attained only through a long and painful struggle for economic adjustment. And during that struggle both the productivity of the resource and the personal fortunes of almost numberless individuals and families would have suffered greatly. Land disposal could have brought no such favorable outcome; and community welfare imperatively demands, in the future as in the past, full retention by the Gov-

ernment of its present authority over the land. Vested rights must not be established, in any form.

The close relationship of national forest range to community welfare is evidenced by the fact that over 4,500,000 acres of improved ranch land and 22,000,000 acres of grazing land are owned by the 27,000 permittees who grazed 1,459,823 cattle, horses, and swine, and 6,394,844 sheep and goats on the national forests during 1927, as shown in Table 12.

TABLE 12.—Grazing permits issued and number of stock grazed on the national forests, calendar year 1927

State	Cattle, horses, and swine				Sheep and goats		
	Permits issued	Stock grazed			Permits issued	Stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Alabama.....	7	40					
Arizona.....	1, 176	208, 559	2, 631	268	117	340, 191	1, 790
Arkansas.....	33	654	6	26	1		15
California.....	1, 947	155, 116	6, 428	179	366	433, 970	2, 990
Colorado.....	3, 095	290, 895	5, 307		854	1, 015, 450	184
Florida.....	6	235		5	2	988	
Idaho.....	2, 848	123, 433	9, 404		962	1, 300, 000	122
Montana.....	1, 983	122, 498	9, 955		462	554, 045	106
Nebraska.....	33	10, 297	564				
Nevada.....	397	54, 349	2, 350		110	307, 890	
New Hampshire.....	20	143	16				
New Jersey.....	1	56	3				
New Mexico.....	1, 868	89, 909	3, 350	145	296	220, 916	11, 696
North Carolina.....	107	325	26	257	11	140	
Oklahoma.....	46	2, 645	86				
Oregon.....	1, 103	87, 864	4, 363	10	431	615, 498	142
South Dakota.....	581	25, 691	1, 604		28	19, 574	
Tennessee.....	27	226		39	1	20	
Utah.....	4, 351	115, 492	4, 621	45	2, 027	754, 898	997
Virginia.....	62	694	6		7	156	
Washington.....	396	10, 492	726		135	162, 084	
West Virginia.....	40	334	70	28	13	1, 348	
Wyoming.....	744	103, 245	4, 113		306	649, 670	
Total, 1927.....	20, 871	1, 403, 192	55, 629	1, 002	6, 129	6, 376, 838	18, 046
Total, 1926.....	22, 295	1, 456, 858	57, 396	1, 085	5, 982	6, 212, 657	15, 666

In comparison with 1926, 53,666 fewer cattle but 164,181 more sheep were grazed. There were 1,424 fewer cattle permittees and 147 more sheep permittees. These differences represent economic adjustments. An improved market for cattle led many owners to liquidate indebtedness, while changes taking place on the ranch properties and open range outside the national forests were largely responsible for the increase in sheep and decrease in cattle.

While no adequate data are available for other localities, it is believed the business in the national forests is far more stable than elsewhere in the range country and that the main problem confronting the Forest Service in the immediate future will be to prevent overexpansion and overstocking

RANGE-MANAGEMENT PLANS

Over 80,000,000 acres within the national forests supply the needs of permitted livestock. This resource is vital to the prosperity of many dependent communities which must have available a permanent and plentiful supply of forage for the season of the year when the local livestock can not be maintained on the ranches. Increased productiveness of the range benefits the community, while if overgrazed ranges necessitate reductions in numbers or in the period of use, the dependent ranch properties have their earning power curtailed proportionately.

The Forest Service system of management aims to meet the best needs (1) of the range itself, (2) of the

related timber, game, water, recreation, and other resources, and (3) of the dependent ranch property. Experience and investigations have shown clearly how the forage plants can be used without loss of range productiveness, and often with its increase. They have shown, too, that observing the needs of the range itself minimizes if it does not entirely eliminate damage to other resources. In other words, it is now generally recognized that good range management is good forest, game, and watershed management. What is best for the range, however, is not always in accord with the conceptions of the owners of livestock and dependent property. Conflict frequently occurs when the growing season of plants is alike on the range and the ranch properties. To reconcile such conflicts the Forest Service is developing, in cooperation with the users themselves, a plan of management for each allotment or range. The plan consists of a map, with explanatory written details. Each plan embodies the essentials of good range practice; i. e., the right class and number of stock for the right season of the year, properly distributed so as to prevent overgrazing of portions and to secure even utilization of the forage crop on the whole range.

It is generally recognized that range productiveness should be measured in terms of quality and quantity of meat and wool, not quality and quantity of forage merely. The production of meat and wool depends upon many factors over which the Forest Service has no control, but in which it is extremely interested. The Forest Service, therefore, encourages, through its contact with individuals and livestock associations, the adoption of better practices in all lines of livestock production. Class, breed, and care of livestock when not on forest ranges are of sufficient importance to merit the careful consideration of all progressive stockmen. "More feed, more care, and better livestock" is still a slogan which might be followed with profit to the industry. The increased interest and response of permittees in the development and application of better practices is notable. It is because of this that the Forest Service has been able to complete plans on 4,415 out of a total of 7,064 range allotments.

GRAZING FEES

Last year's report discussed the settlement of the grazing-fee controversy. In accordance with that set-

tlement a new schedule of fees went into effect on January 1, 1928. While stockmen generally do not want fees raised, it is believed they accept the new rate as fair compensation to the Government for use of a public resource. Only one appeal to the Secretary's office has been made. This appeal, however, affects grazing fees throughout one entire State and involves policy questions of far-reaching importance which will require careful study before a conclusion is reached.

RANGE CONDITIONS

The season of 1927 was on the whole a favorable one for the stockmen, though portions of Montana, Oregon, Washington, and California were over-dry throughout. Most of the Rocky Mountain and intermountain regions received a plentiful supply of precipitation. In the Southwest a rather light winter snowfall was followed by an abundance of early spring moisture. This brought on a good crop of annual forage plants throughout the southern part of the region; but on some of its northern forests the spring was cold and backward. Summer rains with favorable growing conditions left on the range more feed for winter use than has been the case for a number of years.

With both market and forage conditions improved, the industry experienced one of its most prosperous years. In some localities, however, complaint was made that the exceptionally rainy season and resultant rank growth of vegetation produced light lambs. Generally, the financial situation of livestock owners was materially strengthened. The delinquent grazing fees heretofore reported have been collected, except where stockmen have gone out of business.

LIVESTOCK ASSOCIATIONS

Livestock associations are now a part of the community life. It is through such organizations that common problems can be discussed and settled with mutual satisfaction and benefit. These associations are fostered and helped in every possible way in order that a better understanding may be had of the problems of the Forest Service and stockmen alike. Through the meetings of the associations and the advice of their advisory boards local forest officers are greatly aided in making administration harmonize closely with community wishes and welfare. In short, the administration of grazing on the national forests

assumes a greater degree of local self-government than is generally possible in the conduct of public business. In this instance, however, the business of the Government is the business of the stockmen, so far as the best use of forest range is concerned. While the Forest Service makes no effort to dictate the manner in which the stockman conducts that part of his business related to but not directly connected with supervision of the range, it helps progress by enforcing special rules adopted by the associations governing the number and breed of bulls, the purchase and distribution of salt, hiring range riders, etc. Through these special rules a marked improvement in breeds and handling of stock has been secured.

Cooperation exists with 735 officially recognized stock associations, and in 1927, 987 association meetings were attended by 1,164 forest officers and 13,336 stockmen.

LOSSES OF LIVESTOCK

Reducing livestock losses makes the national-forest ranges more productive. Poisonous plants not only cause heavy direct losses but also interfere seriously with proper range use. Small infested areas may prevent the full use of much larger areas. Often use must be postponed until the toxic properties of the plants have disappeared. That may close the range during the part of the grazing season when dependent ranch property most

needs it. Further, by the time that stock can be safely admitted the forage may have reached an unpalatable stage of development, so that an almost total loss of range use results.

To the close of the calendar year 1927 eradication work covered 11,399 acres and cost \$50,395, while 403,150 acres still need eradication work, the estimated cost of which would amount to \$1,781,923.

Losses from poisonous plants, especially from larkspur, seem to be greatly influenced by the character of the season. Why this is true can be settled only by more intensive investigation and experiment.

All kinds of losses except those from natural causes can be materially reduced through such means as poisonous-plant eradication, predatory-animal control, fencing bog holes, and fencing ranges to prevent unnecessary loss from drift. As a rule, national-forest ranges are free from contagious disease, and danger from this source is held to a minimum by the effective inspection work conducted by Federal and State agencies, with which the Forest Service cooperates fully. The total number of stock lost in the calendar year 1927 was 145,746, valued at \$2,001,990—a decrease from the losses in 1926 of 10,232 animals, valued at \$152,540. Table 13 gives further details. Of the losses due to poisonous plants, larkspur accounted for 70 per cent of the number of animals and 63 per cent of the value.

TABLE 13.—*Livestock losses on national forests, 1927*

District	From poisonous plants		From predatory animals, disease, and other causes		Total	
	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats
1.....	274	2, 121	801	13, 017	1, 075	15, 138
2.....	2, 326	3, 582	1, 989	22, 540	4, 315	26, 122
3.....	531	1, 171	6, 811	3, 393	7, 342	4, 564
4.....	1, 876	9, 790	1, 655	43, 228	3, 531	53, 018
5.....	449	1, 874	801	9, 027	1, 250	10, 901
6.....	130	2, 880	508	14, 972	638	17, 852
Total.....	5, 586	21, 418	12, 565	106, 177	18, 151	127, 595

RANGE IMPROVEMENTS

Stockmen have cooperated extensively in the construction of trails, drift, division, and boundary fences, bridges, corrals, and pastures, in the improvement of watering facilities, and in the eradication of poisonous

plants. Without these improvements, control of range use would be difficult and in some cases impossible, and local overstocking, with resultant range depletion, would be inevitable. Fortunately the stockmen have recognized this, and the greater part of the improvements have been constructed at

their expense. An urgent need exists, however, for additional improvements. With the increased grazing fees now in effect range users are looking to the Government to do more. An obligation exists which must be met if present cooperative relationships are to be maintained. Aside from the obligation, range improvements are good business, for they will increase revenues by bettering the range, and will cut down administrative expenses. From 7 to 10 years should suffice to retire the cost of range improvements.

The Forest Service has allotted funds to the limit of the resources which it can consistently make available from present appropriations. Some progress is being made on the more important projects. For example: Lack of control of livestock at the boundary of the forests and during the grazing season has resulted in serious damage to timber reproduction in northern Arizona. Plans were developed in 1925 for the construction of necessary fences and watering places and the introduction of improved methods of handling the stock. This plan

was alternative to a large reduction in the numbers of stock on some ranges and the total elimination of grazing from others. The changes have been almost completed, with marked benefit to the range and to timber reproduction.

Other important projects are waiting. For example, in Oregon range for 14,000 head of sheep is now idle on the Malheur National Forest. The heavy growth of herbaceous vegetation greatly increases the fire hazard to which a large body of virgin timber stands exposed. This condition has been the chief reason for large fires. The hazard could be greatly reduced by grazing, but for this watering facilities must be created. Their estimated cost is \$9,000. Lacking funds available for this purpose, the Forest Service is having to spend approximately \$14,000 a year in fighting the fires, while valuable and important timber goes up in smoke and the Federal Treasury loses some \$2,000 a year in grazing fees that would probably be forthcoming could water be provided.

Table 14 indicates the present status and variety of projects.

TABLE 14.—Range improvements¹ constructed on national forests to December 31, 1927, and additional improvements needed

	District 1	District 2	District 3	District 4	District 5	District 6 ¹	Total
Boundary and drift fences.....miles	409	773	4,669	852	1,103	762	8,568
Water development.....number	266	752	38	726	448	352	2,582
Driveways.....miles	801	1,228	-----	263	44	466	2,802
Bridges.....number	18	21	17	17	7	15	95
Trails.....miles	-----	-----	-----	218	26	52	296
Corrals.....number	67	64	30	101	184	131	577
Cabins.....do	35	-----	-----	3	191	77	306
Pastures.....do	14	-----	-----	8	415	1	438
Poison eradication.....acres	106	7,176	230	3,193	628	76	11,409
Salt troughs.....number	2	-----	-----	25	1,492	1,400	2,919
Cost to stockmen.....dollars	86,019	100,626	2,089,092	172,902	314,729	142,183	2,905,551
Cost to Government.....do	144,485	112,253	128,278	126,557	45,846	46,298	603,717
Total cost.....do	230,504	212,879	2,217,370	299,459	360,575	188,481	3,509,268

RANGE IMPROVEMENTS NEEDED

Boundary and drift fence.....miles	306	244	4,455	549	324	578	6,456
Water development.....number	290	165	356	603	629	565	2,608
Driveways.....miles	120	1	-----	25	-----	99	245
Bridges.....number	34	1	-----	8	3	14	60
Trails.....miles	19	-----	79	129	20	-----	247
Corrals.....number	4	15	128	21	4	27	199
Cabins.....do	17	-----	-----	13	3	22	55
Pastures.....do	-----	-----	-----	15	42	-----	57
Poison eradication.....acres	4,240	112,428	248,111	35,089	2,450	809	403,127
Salt troughs.....number	249	-----	-----	-----	1,794	1,521	3,564
Cost to stockmen.....dollars	585	34,016	251,932	103,304	46,390	73,602	509,829
Cost to Government.....do	73,892	48,966	311,817	258,733	80,971	155,083	929,462
Total cost.....do	74,477	82,982	563,749	362,037	127,361	228,685	1,439,291

¹ Also 24,400 acres of squirrel eradication in district 6. 24,600 acres need work.

RANGE-DESTROYING RODENTS

Prairie dogs, squirrels, gophers, and other range-destroying rodents infest about 7,000,000 acres of national-forest land. They destroy forage enough annually to support 25,000 cattle five months. The loss in carrying capacity varies from 5 to 95 per cent. While it is small in comparison with the total grazing use, it represents a loss to the Government of \$25,000 a year in grazing fees, besides the loss to the livestock industry. Further, unless controlled, infestation is progressive and affects an ever-increasing area.

The problem is made much more difficult by the fact that private and public lands outside the forests are also infested. It must be attacked in a systematic manner. Private land-owners and State and county authorities are cooperating with the Bureau of Biological Survey on areas outside the forest. Such work will prove of little benefit unless adjoining areas on the national forest are controlled at the same time. The Forest Service has cooperated with other owners of land and the Bureau of Biological Survey to the limit of its resources, and some of the worst-infested areas on the national forests have been effectively cleaned up. Much credit is due to the expert knowledge and leadership of the Biological Survey in this work. Nevertheless, at present the control is apparently no more than keeping pace with the natural increase. The problem calls for substantially increased provision for this work on the national forests.

TRESPASSING LIVESTOCK

Another loss in forage and revenue is occasioned by livestock grazing without permit or control. Regulatory measures are applicable only to stock that is valuable and can be identified. The main difficulty is with horses of practically no value, often unbranded or abandoned. The national-forest ranges are supporting over 20,000 such animals. Their presence often results in overgrazing and necessitates reducing the number of livestock for which fees are paid. About \$20,000 annually is thus lost to the Treasury. Further, good range administration is interfered with. Roaming at will and scattered over large areas, these wild horses make it impossible to regulate properly the numbers of stock on the ranges. They can not be handled un-

der ordinary methods; they consume the salt placed on the range by permittees for their domestic stock and make more difficult and expensive the upkeep of fences and other improvements; and they cause reluctance on the part of permittees who comply with all regulations to continue paying fees for grazing their stock while stock not under permit are consuming feed that their own animals badly need.

In 1925 a regulation was promulgated authorizing local forest officers to advertise and impound stock found in trespass and to sell any horses not redeemed by the owners. Over 9,000 animals have been handled under the regulation, at an average cost of over \$3 per head. The work is of necessity expensive. Some \$11,000 received for redeemed stock was used for reimbursement of the expenditures, but this has now been held illegal, and after July 1 such receipts must be covered into the Treasury as "miscellaneous receipts, Forest Service." This ruling will greatly retard the work.

RECREATION AND GAME

The number of people visiting the national forests for recreation increased 8.2 per cent over the number in 1926. Special-use permittees and their guests increased 19.7 per cent, hotel and resort guests 2.4 per cent, picnickers 9.2 per cent, and transient motorists 11.8 per cent, while campers decreased 10.3 per cent.

During the year 156 camp grounds were improved in whole or in part; 919 camp grounds now have some improvements, as compared with the more than 1,500 camp grounds now being used heavily by the public. The expenditures for this purpose were \$42,517. The total cost of the improvements to date has been \$238,013, of which \$44,899 has been contributed in cash, material, or labor by private or public cooperators.

The study of the so-called "wilderness areas" or areas believed to be most useful if retained in a condition of relative undevelopment, continued throughout the year, and in one district was completed. It is not proposed unduly to curtail timber cutting, grazing, water development, mining, or other forms of economic utilization within such areas, but rather to guard against their unnecessary invasion by roads, resorts, summer-home communities, or other forms of use incompati-

ble with the public enjoyment of their major values.

During the year a special committee was appointed by the Secretary of Agriculture to make a study of the Mount Hood region in Oregon. This was because of local protests against a decision of the Forester refusing to grant a permit for the construction of a cableway to the summit. The findings of this committee will be of great value in determining whether such features of development will be compatible with the best use of the area by the public. In addition to specific recommendations for the Mount Hood area, the committee has been asked to submit recommendations regarding the proper forms of use and development within other similar areas in the State of Oregon, and in other States.

Studies and observations of wild life on the national forests were continued. Plans of administration are being developed as rapidly as the problems involved are ascertained and personnel and funds will permit. The major problems concern (1) methods of restocking or increasing game, (2) reliable game estimates, (3) reliable estimates of the game-carrying capacity of each forest, and (4) methods of holding the number of game animals in balance with carrying capacities.

It was found early in the administration of national forests that game animals have wonderful recuperative powers. Where they had not been completely exterminated adequate protection produced satisfactory results. Elsewhere restocking proved feasible. In either case, however, absolute protection proved a necessity.

Game refuges or sanctuaries brought about rapid increases and the restocking of adjoining areas. When, however, ruminant game animals reach the point of fully stocking the refuge and the drift from the area is inadequate to take care of the further increase, overstocking occurs, with resultant overgrazing and damage to timber and range. This has been exemplified on the Grand Canyon Game Preserve in Arizona and on certain elk ranges of the Lewis and

Clark, Absaroka, and Teton National Forests.

The national forests embrace both Federal and State refuges. The Forest Service is endeavoring to work out constructive management plans on Federal refuges and is actively cooperating in the creation and protection of State refuges. Over 19,000,000 acres of national-forest lands are included within refuges of the latter class, and about 10,000,000 acres of the total are grazed by domestic livestock. The dual use of such areas does not in itself present a particularly difficult problem. The numbers of domestic animals can be so regulated that ample feed is provided for game, up to a certain point. Fully 60 per cent of the carrying capacity of the 10,000,000 acres under dual use is reserved for game animals. Similarly, within the 1,268,000 acres of Federal game refuges included in the national forests, domestic stock consume only a small portion of the available forage. The fact that the feed requirements and habits of the different classes of animals are not alike makes it possible to graze all classes on the same range without material conflict, and without overgrazing so long as the numbers of each class do not exceed the capacity of the range to grow the forage species respectively preferred.

The determination, however, of a safe game-carrying capacity for ranges of widely varying conditions is not easy. For domestic livestock, experiments, investigations, and experience have developed reliable methods of determining this, but they can not be applied to game. Resort is therefore made to the method of trial and test, with an ample margin of safety. Obviously, the first necessity is to be able to determine with reasonable accuracy the number and species of game animals. For this various methods are used, some of which are wholly observational. As a working basis, however, it is believed the estimates shown in Table 15 are fairly reliable and will serve the purpose until more intensive conditions prevail and better methods have been developed.

TABLE 15.—*Number of big-game animals and beaver on national forests*

[Estimates as of December 31, 1927]

State	Antelope	Bear		Caribou	Deer	Elk	Moose	Mountain goats	Mountain sheep	Beaver
		Black or brown	Grizzly ¹							
Alaska.....		2 6,100	2,500	20	59,300	9	2,055	9,500	2,006	1,500
Alabama.....					125					
Arizona.....	2,157	595	20		59,009	841			262	93
Arkansas.....					1,450					
California.....	612	10,303			238,645	126			685	375
Colorado.....	114	2,641	19		27,757	8,519			3,835	43,905
Florida.....		25			650					
Idaho.....	2,065	5,728	142	10	57,613	7,965	639	3,246	1,403	15,747
Michigan.....		31			225					
Minnesota.....		1,385		3	7,300		1,850			5,792
Montana.....	976	5,433	433		52,368	10,927	1,168	4,005	1,880	17,111
Nebraska.....					50					
New Hampshire.....		700			3,000		3			2
New Mexico.....	1,047	964	21		35,831	135			200	1,140
Nevada.....	177				5,455				170	222
North Carolina.....		90			4,120	35				
Oklahoma.....	20	2			300	350				
Oregon.....	29	6,911	1		71,508	5,785			40	5,238
Pennsylvania.....		150			1,175	18				30
South Dakota.....	2				2,946	856				2,337
Tennessee.....		27			85					
Utah.....		435	13		32,147	2,090			177	5,704
Virginia.....		450			48	75				
Washington.....		7,130	98	2	27,668	9,712	2	2,583	10	8,799
West Virginia.....		200			20					
Wyoming.....	466	1,717	133		11,791	26,736	2,233		2,583	9,030
Total.....	7,665	51,017	3,380	35	700,586	74,179	7,950	19,334	13,251	117,027

¹ Including Alaska brown bear.² Black bear only.

Only with regard to deer and elk are acute problems of game management faced that relate to holding in due balance the number of animals and the carrying capacity of the land. In spite of liberal open seasons there is everywhere a steady increase in deer, amounting to about 5 per cent annually. About 10 per cent is reported as being taken by hunters each season. As in past seasons, there appear to have been about three or four hunters for each deer killed. Nevertheless, the increase of deer in certain localities is raising a definite question as to the permanent adequacy of the food supply and as to means of regulating the number of animals and utilizing the increase to best advantage.

The problem of the Kaibab herd in northern Arizona is still unsolved. The situation is far from satisfactory. The number of deer far exceeds the number which the available feeding grounds can maintain, but the State of Arizona objects to a reduction of the number by raising the bag limit or by employing Government hunters for the purpose, with such disposition of the meat as may be possible. The

herd, which now contains approximately 28,000 head, is not holding its own. For two winters in succession a large part of the fawns born the previous year have died. These are both uneconomic and inhuman conditions. The authority of the Secretary of Agriculture to apply a remedy was affirmed by the Federal district court, but an appeal by the State is to be determined by the Supreme Court of the United States.

Elk have everywhere made excellent increases with good calf crops and low winter losses. Some of the herds are approaching the point above which further increases are fraught with danger. During the 1927 hunting season hunters killed about 1,000 of the Jackson Hole herd. This is about the usual number. Approximately 1,500 of the Yellowstone or Park herd were killed—not enough to offset the increase. The history of both these herds shows that whenever they rise, as at present, above 20,000 severe winter losses are only a matter of time.

The plants of elk elsewhere are all prospering. Some States very wisely have established open seasons to keep

the number down to the limit of the available range.

The number of antelope reported in Table 15 is about 10 per cent greater than last year. While the herds not in captivity are increasing, for reasons not yet clear antelope do not appear to thrive under fence. The little herd on the Wichita Game Preserve in Oklahoma has not prospered during the last four years, in spite of every possible attention.

Black and brown bear show about a 10 per cent increase over 1926, due possibly to closer estimates. Extending the protection of the game laws to these animals has contributed greatly to their increase.

In Table 15 the giant Alaska brown bear is classified with the grizzly. A special study of this bear made by forest officers in Alaska last year afforded a closer estimate of their number, and this caused a heavy decrease in the number reported. Outside of Alaska only 880 are listed, of which nearly 50 per cent are in Montana. The record shows not a single grizzly in any national forest in California—a State in which these animals were once numerous. The buffalo was never so near extinction as is the grizzly to-day.

Mountain goats and mountain sheep made small increases, but on most of the national forests moose are seemingly on the decline. Beaver continue to increase in all parts of the West. Their value to the irrigationists of the Intermountain States has been well established, while the income from pelts taken from surplus animals promises to be a permanent source of income to State game funds.

For several years the scarcity of grouse throughout the mountains of the West has been ascribed to tramping of the nests by grazing sheep. For the last two years forest officers have been taking notes on this matter. Reports for both seasons indicate that, generally speaking, the eggs of grouse are laid and hatched and the young have left the nests before the sheep reach the nesting grounds. The scarcity of grouse in any section may be due to disease or to raids upon the nests and young by small fur-bearing or predatory animals.

Forest officers referred to State officials for prosecution 496 game-law cases, which resulted in 199 convictions. Forest officers prosecuted 109 cases, which resulted in 94 convictions. Forest officers issued 7,230 State game licenses and examined 29,333.

WATER POWER

Of the water-power permits issued by this department prior to the passage of the Federal water power act, 272 were outstanding at the end of the fiscal year. For 185 rental charges were involved; the rest were free. The estimated average output at minimum discharge was 518,085 horsepower for the rental permits and 26,225 horsepower for the others. The corresponding lengths of transmission line were 942.46 and 155.40 miles, of which respectively 700.03 and 127.83 miles were on land within the national-forest boundaries.

Permits and licenses under supervision for and at the request of the Federal Power Commission at the close of the year numbered 257, as against 247 a year previously. The commission requested 48 field investigations and reports during the year, and 40 reports were made. Forest Service engineers also made several valuations and appraisals. The Federal Power Commission received 54 applications for projects in whole or in part on national-forest land. This represented approximately 62 per cent of the total number filed with the commission. Under authority granted by the Federal Power Commission the district foresters issued 6 permits for projects of 40-horsepower capacity or less and for periods not exceeding 10 years.

Upon the field engineers of the Forest Service falls the work of making inspections of design and construction of all dams erected within national forests under licenses issued by the Federal Power Commission. The Federal water power act gives the commission authority to make requirements in the interest of public safety or the proper development of the power resources of the Government's lands. This authority is exercised on the national forests through the Forest Service.

In addition to dams erected under license from the Federal Power Commission, dams may be erected in the national forests (1) under easements granted by several general acts of Congress, (2) under special grants made by Congress to specific agencies, and (3) under special-use permit from the Forest Service for uses or purposes other than water power or those specified in the laws granting easements and rights of way.

It is becoming increasingly important that these works be adequately supervised from an engineering stand-

point. The steady advance of settlement and accumulation of property increase the possibilities of destruction and demand factors of safety which might not have been justified under pioneer conditions. The Forest Service has ample authority to include in its permits for dam construction such requirements as to prior approval of designs and plans of construction as it may consider necessary to safeguard life and property, and this is being done.

Just how far the Forest Service can and should go in imposing such requirements when dams are constructed under special grants of Congress or under the general acts granting easements is another matter. The execution by applicants for easements of stipulations necessary to prevent the destruction of Government property or to safeguard other national-forest interests can, it seems certain, usually be required as a prerequisite to the approval of such easements unless special terms of the law exclude this course. Such protection of the interests of the Government might necessitate the requirement of advance approval of dam designs and plans of construction, and even provision for the permanent security of the dam. The right and duty of each State to provide such checks as are necessary to safeguard private property and human life is of course recognized. It does not, however, seem proper that the Forest Service should regard this as a matter outside its jurisdiction and with which it therefore should not be concerned in case the State fails to provide adequate checks. The Federal Government as a property owner should exercise the same precaution that any responsible private owner would wish to, by making sure that misuse of lands under its control does not unnecessarily jeopardize other property and human life.

The basis for coordinating the use of roads and transportation routes needed for power development with their use for other purposes incidental to the protection, administration, and utilization of the national forests has been worked out with the Federal Power Commission. In one case a power company endeavored to have the project license a railroad which would have controlled the only practicable outlet for over 6,000,000 feet of merchantable timber. This was ques-

tioned, and the railroad was included only on terms which will make its transportation facilities also available on equitable terms to the public and to timber purchasers from the Forest Service.

As to vehicle roads, the Federal Power Commission has agreed with the Forest Service that when built by licensees primarily for the project construction but needed for project operation and maintenance such roads should be open to public use as well as to use by the Forest Service. During the year a power company that had a very great investment in power structures and had expended large sums for road construction sought to be excepted from the regular policy because the amount of public use would be very great on certain roads, necessitating much larger expenditures for road maintenance and betterment than if traffic were restricted to the power company and the Forest Service.

This resulted in a modification of the policy so that hereafter the public is allowed a reasonable participation in the advantages accruing from pioneer development work, without permitting this to hamper the primary work of power development or to become a material burden on the licensee. Road built in this country by the pioneer whether an individual settler or a great mining company, have in the past always been open to the free use of everyone who wished to follow. The Forest Service is perpetuating this policy so far as it is fairly applicable to modern conditions.

ROADS AND TRAILS

Data on appropriations expenditures, balances, and accomplishments are shown in Tables 16 to 20.

Under instructions from the Bureau of the Budget, the program for the fiscal year was based on a total expenditure from the forest-highway and forest-road development funds of sum not to exceed \$7,500,000. This represented a marked reduction from the amount expended the preceding year. Every precaution was taken to keep the expenditures within the limit set, and it is probable that some portion would have been unexpended if weather conditions last spring had not permitted contractors to begin work earlier than was expected. The actual expenditures were \$7,533,044, an overrun of approximately 0.4 per cent.

TABLE 16.—*Classification of mileage in forest road and trail system and expenditures required to complete system to satisfactory standard*

Class	Total	Satisfactory standard	Unsatisfactory standard	Nonexisting	Expenditures required to complete
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	
Forest highways.....	15,272	5,680	8,387	1,205	\$151,698,893
Forest development roads.....	39,285	14,917	13,154	11,214	50,380,292
Trails.....	128,347	83,615	10,036	34,696	5,840,322
Total.....					207,919,507

The expenditures for maintenance are increasing not only in amount but in percentage of the total, while the cooperative assistance has fallen off. In consequence less money is available for construction. Practically no cooperative assistance is to be expected in trail maintenance nor on a large percentage of the forest-development roads. On the forest highways it is hoped that as the most urgent needs for construction are met the States and counties will take on some of the maintenance costs now borne by the Federal Government. At present the situation is very serious in several States, since the funds remaining to the Government after financing the necessary maintenance fall far short of what is urgently required for construction and betterment work. The forest road and trail system comprises the roads and trails which, on the basis of present knowledge, will be needed within 10 years. On the basis of present costs, standards, appropriations, and maintenance expenditures, with no cooperative assistance completion of the system as it now stands is over 40 years away, to say nothing of the new needs that will arise in the interim.

During the winter the House Committee on Roads held extended hearings on proposed road legislation. A considerable period was given to bills legislatively authorizing appropriations for Federal-aid and forest roads for the fiscal years 1930 and 1931. Several of those testifying before the committee on these bills and another authorizing \$3,500,000 yearly for three years, to be expended for roads on reserved and unreserved public lands, stressed the need of greater progress on the main highways within the national forests and presented data showing that decidedly less progress is being made on such highways than on similar highways outside the forests.

Those testifying were primarily concerned with the roads on the 7 per

cent and State systems. An equally strong case can be presented for the county and community roads, especially those on the forest-development system. Statements have frequently been made of the importance of the system to the national forests, and of their service in reducing fire losses and fire-suppression costs. Over five years have elapsed since the work on these roads and trails was started. It is now clearly evident that their value has not been overstated.

Possibly the greatest single benefit to fire control has come from having under Forest Service supervision road and trail construction crews ready for instant service on fire suppression in regions of high fire risk. The crews are utilized full time for fire fighting when so needed, and at other times on construction and maintenance work. It has been estimated that to obtain the same measure of protective value without the present coordination between the road and trail work and the protective activities would require an additional protection appropriation of at least \$500,000 annually. Also, a large portion of the time of the added protective force would not be utilized. Scores of examples could be given of the specific value of roads and trails to national-forest protection and administration and to the utilization of the forest resources, particularly timber. In many cases the value received has already far exceeded the investment made in the roads and trails.

At its last session Congress authorized appropriations of \$7,500,000 for each of the fiscal years 1930 and 1931, under the provisions of section 23 of the Federal highway act. This amount is the same as that legislatively authorized for the past few years. For the fiscal year 1929, the appropriation under section 23 of the Federal highway act is \$7,500,000. A most important change was made in the legislative provision relative to incurring ob-

ligations against amounts unappropriated but subject to obligation. The Secretary of Agriculture is now mandated to obligate the entire \$7,500,000 authorization for the fiscal year 1929. Carrying out this mandate means that

the \$7,500,000 appropriation already made will be insufficient to make a necessary payments during the fiscal year. A supplemental appropriation of an amount which can not now be definitely determined will be required.

TABLE 17.—Construction, improvement, and maintenance of roads and trails from forest road appropriations and other Federal and cooperative funds, by States

State	Fiscal year 1928				Total to June 30, 1928		Expenditures to June 30, 1928		
	Constructed		Maintained		Constructed		Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails	Roads	Trails			
<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>				
Alabama.....	15.9		19.0		26.0		\$69,186.13	\$1,982.65	\$71,168.
Alaska.....	10.8	51.7	175.0	108.9	197.4	326.8	3,610,814.28	279,789.45	3,890,603.
Arizona.....	101.6	10.5	1,184.9	475.0	982.7	1,502.0	4,290,345.57	853,263.07	5,143,608.
Arkansas.....	70.9	12.5	144.3	182.2	417.1	474.3	854,313.68	25,247.73	879,561.
California.....	302.2	223.9	2,427.0	6,130.3	1,588.1	2,616.7	10,463,578.00	3,503,140.81	13,966,718.
Colorado.....	99.1	784.4	700.4	8,294.1	1,164.2	4,104.6	5,430,354.22	816,384.56	6,246,738.
Florida.....	28.0		152.9		153.6		267,813.74	136,311.18	404,124.
Georgia.....	15.3		19.1	168.6	48.1	168.6	357,200.98	37,044.51	394,245.
Idaho.....	100.6	1,321.8	1,702.9	9,752.5	1,776.2	8,847.9	10,813,912.63	1,488,787.27	12,302,699.
Illinois.....							8.00		8.
Kansas.....					3.4		2,111.51		2,111.
Kentucky.....				8.0			578.49		578.
Maine.....			5.3	40.8	5.3	40.8	29,573.28		29,573.
Maryland.....									
Michigan.....	9.0		343.0		31.2		57,822.21	393.45	58,215.
Minnesota.....	70.0	7.8	73.0	85.0	330.0	112.0	579,221.05	241,556.30	820,777.
Montana.....	32.1	873.2	1,214.2	7,822.3	887.7	3,803.3	6,496,277.16	580,225.07	7,076,502.
Nebraska.....			50.4		46.3		71,629.76	990.80	72,620.
Nevada.....	5.1	16.0	378.3	577.5	428.1	776.5	1,119,527.29	143,946.65	1,263,473.
New Hampshire.....		5.5	30.9	330.2	35.0	335.7	235,648.11	18,474.83	254,122.
New Jersey.....			24.0				147.54		147.
New Mexico.....	63.4	42.0	488.2	1,155.0	655.4	1,358.3	3,193,297.27	293,153.33	3,486,450.
New York.....			22.0				77.32		77.
North Carolina.....	4.0	26.0	168.5	568.3	175.2	594.3	576,238.47	55,942.45	632,180.
North Dakota.....					1.0		57.75		57.
Oklahoma.....			34.1	1.5	24.7	16.5	47,724.59	10,988.63	58,713.
Oregon.....	357.3	1,473.9	3,839.6	8,337.0	2,468.0	4,692.7	9,925,460.29	5,446,622.78	15,372,083.
Pennsylvania.....	.4		75.0	10.0	42.4		53,953.03	1,005.00	54,958.
Porto Rico.....	3.6			36.0	4.6	36.3	15,284.12	550.00	15,834.
South Carolina.....			43.9		16.3	4.0	77,826.23	15,170.92	92,997.
South Dakota.....	27.1	8.5	150.1	29.5	268.2	61.7	666,637.04	185,679.51	852,316.
Tennessee.....	7.1	7.0	39.3	452.6	89.1	457.6	280,393.70	131,161.29	411,554.
Utah.....	33.4	327.6	580.1	1,471.1	990.2	3,152.7	2,772,610.39	723,767.92	3,496,378.
Virginia.....	12.5	16.0	92.3	438.6	124.1	698.1	444,139.54	36,740.41	480,879.
Washington.....	103.0	941.3	868.5	6,214.0	863.9	3,145.5	6,273,413.45	1,477,726.22	7,751,139.
West Virginia.....	6.6	16.5	38.7	77.0	49.5	265.0	123,373.29	3,825.98	127,199.
Wyoming.....	58.7	296.0	598.3	3,221.8	929.6	2,004.5	3,517,361.91	369,620.01	3,886,981.
Total.....	1,537.7	6,462.1	15,683.2	55,987.8	14,822.6	39,596.4	72,717,912.02	16,879,492.78	89,597,404.

TABLE 18.—*Distribution among the States of the appropriations and apportionments for the fiscal year 1929*

State	10 per cent fund	Forest highway fund			Forest road-development fund			Total appropriated and authorized to be obligated
		Appropriated	Additional amount authorized to be obligated	Total	Appropriated	Additional amount authorized to be obligated	Total	
Alabama.....	\$121.50	\$1,665	\$2,55	\$4,216	\$7,070	\$4,862	\$11,932	\$17,155.50
Alaska.....	8,976.70	184,324	282,319	466,643	14,456	9,942	24,398	598,012.70
Arizona.....	31,763.99	112,583	172,438	285,021	80,800	55,571	136,371	513,010.99
Arkansas.....	2,885.83	15,097	23,122	38,219	24,400	16,781	41,181	90,310.83
California.....	136,020.85	265,236	406,247	671,483	261,332	179,735	441,067	1,389,581.85
Colorado.....	41,537.15	130,037	199,171	329,208	87,697	60,315	148,012	587,891.15
Florida.....	2,146.23	4,704	7,205	11,909	13,999	9,628	23,627	40,183.23
Georgia.....	1,062.94	2,884	4,418	7,302	11,210	7,709	18,919	28,817.94
Idaho.....	67,863.84	198,548	304,104	502,652	384,767	264,630	649,397	1,325,468.84
Illinois.....		151	232	383				464.00
Kentucky.....	230.23							230.23
Maine.....	193.75	525	805	1,330	3,958	2,723	6,681	8,484.75
Maryland.....	15.00							15.00
Michigan.....	888.62	1,364	2,088	3,452	965	663	1,628	6,692.62
Minnesota.....	2,544.50	11,044	16,916	27,960	19,376	13,326	32,702	69,078.50
Montana.....	21,555.10	156,097	239,086	395,183	168,955	116,202	285,157	784,884.10
Nebraska.....	1,040.18	1,819	2,786	4,605	694	477	1,171	7,783.18
Nevada.....	8,834.97	37,078	56,789	93,867	2,492	1,713	4,205	126,617.97
New Hampshire.....	2,638.82	7,008	10,733	17,741	13,031	8,962	21,993	46,097.82
New Jersey.....	70.17							70.17
New Mexico.....	12,977.21	82,322	126,089	208,411	71,802	49,383	121,185	386,340.21
New York.....	4.00							4.00
North Carolina.....	2,426.73	4,917	7,530	12,447	20,603	14,170	34,773	52,259.73
Oklahoma.....	697.74	817	1,252	2,069	203	139	342	3,543.74
Oregon.....	68,660.69	245,755	376,410	622,165	268,486	184,655	453,141	1,274,621.69
Pennsylvania.....	1,173.56	2,703	4,139	6,842	3,710	2,552	6,262	15,713.56
Porto Rico.....		205	315	520	149	103	252	882.00
South Carolina.....	455.39	907	1,388	2,295	3,083	2,120	5,203	8,434.39
South Dakota.....	12,515.44	15,491	23,727	39,218	11,619	7,991	19,610	79,579.44
Tennessee.....	1,600.26	4,595	7,038	11,633	19,507	13,417	32,924	48,600.26
Utah.....	19,880.58	66,519	101,884	168,403	29,959	20,605	50,564	274,212.58
Virginia.....	6,136.58	6,161	9,437	15,598	16,559	11,389	27,948	52,958.58
Washington.....	57,601.19	130,527	199,920	330,447	179,898	123,726	303,624	761,065.19
West Virginia.....	777.39	2,214	3,392	5,606	12,465	8,573	21,038	28,599.39
Wyoming.....	25,214.78	84,203	128,969	213,172	44,255	30,438	74,693	357,845.78
Total.....	540,511.91	1,777,500	2,722,500	4,500,000	1,777,500	1,222,500	3,000,000	8,985,511.91

TABLE 19.—*Distribution among the States of the total apportionments, including the fiscal year 1929*

State	10 per cent fund	Section 8 fund	Federal forest road construction fund	Forest highway fund	Forest road development fund	Grand total
Alabama.....	\$732.44	\$15,456.04	\$1,922.31	\$24,346.00	\$44,208.00	\$86,664.79
Alaska.....	142,152.47	469,102.30	193,549.95	3,569,316.00	180,736.00	4,554,856.72
Arizona.....	532,297.06	653,759.82	501,984.55	2,154,248.00	1,049,670.00	4,891,959.43
Arkansas.....	91,763.76	174,939.40	128,773.38	261,630.00	338,747.00	995,853.54
California.....	1,211,436.18	1,468,821.13	1,206,815.23	5,244,699.00	3,081,467.00	12,213,238.54
Colorado.....	592,936.95	758,644.90	777,307.26	2,581,765.00	1,294,252.00	6,004,906.11
Florida.....	30,737.33	119,528.14	21,534.94	87,861.00	104,802.00	364,463.41
Georgia.....	8,406.86	52,216.78	134,387.16	64,128.00	118,862.00	378,000.80
Idaho.....	782,431.70	1,196,206.13	1,367,402.82	3,927,232.00	4,805,310.00	12,078,582.65
Illinois.....				1,165.00	396.00	1,561.00
Kansas.....	1,867.27					1,867.27
Kentucky.....	722.72				86.00	808.72
Maine.....	2,203.09	32.41	3,738.77	9,867.00	19,485.00	35,326.27
Maryland.....	70.05					70.05
Michigan.....	2,016.58	7.00	3,000.00	17,876.00	55,787.00	78,686.58
Minnesota.....	31,512.62	8,106.78	108,352.03	225,585.00	305,367.00	678,923.43
Montana.....	514,610.51	753,376.05	731,497.39	3,120,251.00	2,547,094.00	7,666,828.95
Nebraska.....	16,655.44	18.98		38,142.00	26,838.00	81,654.40
Nevada.....	148,127.76	194,809.92	82,265.33	744,465.00	103,078.00	1,272,746.00
New Hampshire.....	28,366.45	341.66	10,941.30	126,662.00	114,672.00	280,983.41
New Jersey.....	118.99				83.00	201.99
New Mexico.....	311,208.15	429,627.16	509,215.36	1,631,095.00	854,800.00	3,735,945.67
New York.....	4.00				20.00	24.00
North Carolina.....	28,722.23	84,801.99	176,890.28	102,524.00	224,834.00	617,772.50
North Dakota.....	45.75	7.00				52.75
Oklahoma.....	8,515.55	65.49	2,775.17	18,368.00	22,297.00	52,021.21
Oregon.....	803,288.55	1,428,939.01	1,077,552.29	4,428,993.00	3,564,858.00	11,303,630.85
Pennsylvania.....	1,466.94	24.04	21.42	22,609.00	52,441.00	76,562.40
Porto Rico.....	3.70	7.00	3,343.09	4,877.00	11,813.00	20,043.79
South Carolina.....	1,723.63	402.10	48,028.61	10,755.00	39,137.00	100,046.34
South Dakota.....	136,495.55	83,566.15	79,341.53	277,794.00	171,017.00	728,214.23
Tennessee.....	15,984.93	78,433.37	28,092.79	78,298.00	140,629.00	341,438.00
Utah.....	340,535.16	445,415.26	464,562.35	1,328,702.00	510,757.00	3,089,971.71
Virginia.....	35,122.10	58,390.16	71,902.26	111,967.00	206,965.00	484,346.53
Washington.....	480,748.75	938,696.42	712,201.40	2,539,798.00	2,554,629.00	7,226,073.57
West Virginia.....	4,104.46	12,830.41	5,049.24	34,138.00	101,441.00	157,563.11
Wyoming.....	350,002.93	471,257.31	547,551.79	1,710,844.00	853,422.00	3,933,078.00
Undistributed.....		102,169.69				102,169.69
Total.....	6,657,138.61	10,000,000.00	9,000,000.00	34,500,000.00	23,500,000.00	83,657,138.61

TABLE 20.—*Condition of forest road funds on June 30, 1928*

Fund	Appropriations	Expenditures	Unexpended balance
10 per cent.....	\$6,116,626.70	\$5,873,933.97	\$242,692.73
Section 8.....	10,000,000.00	9,701,042.57	298,957.43
Federal forest road construction.....	9,000,000.00	8,986,736.93	13,263.07
Forest highway.....	30,000,000.00	27,353,199.27	2,646,800.73
Forest road development.....	20,500,000.00	19,238,865.51	1,261,134.49
Total.....	75,616,626.70	71,153,778.25	4,462,848.45

MAPS AND SURVEYS

During the year the Forest Service published for its administrative use 28 maps on the scale of one-fourth inch to the mile, 18 maps on the scale of one-half inch to the mile, and 27 atlas pages on the scale of 1 inch to the mile. Two special forest maps on the scales of 1 inch and three-eighths inch to the mile, respectively, were also printed. Five presidential proclamation diagrams were issued in cooperation with the Department of State.

The photographic laboratory made practically 104,000 square feet of Van Dyke, photostat, solar bromide, and blue prints, besides preparing 6,000 lantern slides and developing over 4,000 rolls of film and making 82,000 contact prints.

One of the largest individual jobs that has ever been handled by the drafting organization was the preparation of maps to accompany the report on the Mississippi flood situation. The work consisted of assembling and presenting in map form a vast volume

of data on physical features of the Mississippi basin. Separate wall maps showed natural vegetation, forest lands, critical areas, mean annual runoff, protection under the Clarke-McNary law, and the effect of deforestation on normal stream flow. These maps were prepared for congressional hearings. Reductions for inclusion in the Forester's special report on the subject were also made.

The only topographic survey of magnitude conducted during the year covered approximately 440 square miles on the Shasta National Forest, in California. This survey was based on accurate horizontal and vertical data and fully conformed to the standards prescribed by the Federal Board of Surveys and Maps. The cost was approximately \$20 per square mile. Several considerably smaller projects involving timber, grazing, and land-exchange areas were also topographically surveyed.

The great need for better maps of the more remote areas of extreme fire hazard has necessitated during the past few years so-called "drainage surveys." These surveys are not as accurate as regular topographic surveys but differ most from them in showing the configuration of the ground by rough form lines instead of contours. The drainage and cultural features are located to a standard fairly comparable to the regular quadrangle surveys executed by the Geological Survey. The horizontal control is to the standard prescribed by the Board of Surveys and Maps and is sufficiently perpetuated by bronze tablets to permit the initiation of regular topographic surveys from the tablets at any future time. This kind of survey costs about one-third as much as a regular topographic survey and will serve all administrative purposes until the latter can be made. During the year 1,044 square miles of virgin area were mapped on a drainage basis.

Triangulation nets were extended over approximately 925 square miles of the Powell National Forest in Utah and 500 square miles of the Wyoming National Forest in Wyoming, prepara-

tory to making grazing and drainage surveys.

An aerial survey of a portion of the Nezperce National Forest in Idaho was started, but inclement weather and condemnation of the airplane used for the work shortly after it was initiated forced its abandonment. The results secured, however, gave evidence that this method of mapping forest areas has decided promise.

The Geological Survey initiated but did not complete the survey of seven quadrangles which lie wholly or partly within the national forests. Accurate topographic maps though badly needed are lacking for 54 per cent of the national forests, and the Geological Survey has been unable to make much progress in providing them.

The General Land Office completed the survey of practically 100 townships within or partly within the national forests.

RESEARCH

The itemized statement of Forest Service expenditures on page — shows a total for research of \$1,139,644.32, subclassified under the four heads of (1) silvical investigations, (2) forest-products investigations, (3) range investigations, and (4) taxation study. The expenditure figures are those of the Forest Service cost-keeping records, and consequently include some expenditures for research undertaken by local forest officers as an incident to administration. Such incidental research projects are in addition to the body of systematically planned, organized, and correlated studies which seek the basic knowledge necessary for the successful practice of forestry in the United States. The latter work is financed (1) from appropriations made specifically for the purpose and from allotments of Clarke-McNary funds for the tax study, as prescribed by that law; (2) from appropriations for the Forest Service as a whole, for such purposes as general expenses, salaries, and supplies; and (3) from contributed cooperative funds, public and private. The expenditures last year from these three sources are compared with those for the fiscal year 1927 in Table 21.

TABLE 21.—Expenditures for systematic research, 1927 and 1928

Fiscal year	From specific appropriations for research	From general appropriations	From cooperative funds	Total
1928.....	\$929, 762. 25	\$58, 182. 84	\$54, 389. 88	\$1, 042, 334. 97
1927.....	728, 109. 34	175, 438. 25	38, 026. 10	941, 573. 69

The amounts shown as derived from general appropriations are partly incidental contributions of various kinds, which are made in fluctuating degree, but in 1927 were mainly and in 1928 to a much less extent allotments of definite sums made to the branch of

research at the beginning of the fiscal year, for salaries and expenses. Table 22 shows the funds either directly appropriated for or allotted to each class of research work in 1928 as compared with 1927 and also with 1929.

TABLE 22.—*Appropriations and allotments for research work in 1928 as compared with those in 1927 and 1929*

Class of research	Fiscal year						
	1927			1928			1929, directly appropri- ated
	Directly appropri- ated	Allotted	Total	Directly appropri- ated	Allotted	Total	
Silvical investigations.....	\$250,000.00	\$38,080.00	\$288,080.00	\$337,000.00	\$16,080.00	\$353,080.00	\$354,300.00
Forest products investigations.....	403,264.00	90,420.00	493,684.00	500,000.00	3,420.00	503,420.00	505,000.00
Range investigations.....	40,320.00	9,435.00	49,755.00	44,880.00	4,875.00	49,755.00	49,755.00
Taxation study.....	35,972.24	-----	35,972.24	48,665.00	-----	48,665.00	60,000.00

It will be seen that the increases in the research subappropriations for silvical and forest-products investigations were accompanied by material reductions in the drain upon general Forest Service funds. The increases were in fact largely offset by curtailments of other appropriation items and represent in the main not expansion of the work but a more logical method of financing it. The appropriation funds assigned to forest-products research for the fiscal year 1929 exceeded those for 1927 by only \$11,316. The increase for silvical investigations was \$66,220, of which \$60,000 represents provision by Congress for establishing two new forest experiment stations.

As has already been explained, research is the oldest activity of the Forest Service. It dates from 1876, when the first appropriation for Federal work in forestry was made. It is fundamental both to public and to private forestry. The legislative authorizations of the McSweeney-McNary law have created a basis for a less piecemeal method of financing and conducting the work, and consequently for a more orderly, comprehensive, and sustained attack upon the great number of unsolved problems that now hold back the development of sound policy and practice.

FOREST EXPERIMENT STATIONS

The two new forest experiment stations carry further the plan for a series of such stations to cover the major

forest regions of the United States. One was located at Columbus, Ohio, to be conducted in cooperation with the Ohio State University and to work largely upon problems relating to farm wood-lot management in the Ohio and central Mississippi Valley region. The other, the Allegheny station, was located at Philadelphia, where it will work in cooperation with the University of Pennsylvania and whence it will serve the Middle Atlantic group of States. These stations complete the organization for systematic forest research in the East. The other eastern stations are the Northeastern, the Lake States, the Appalachian, and the Southern.

For the West there are the California and the Pacific Northwest forest experiment stations, together with two smaller ones, the Northern Rocky Mountain and the Southwestern, which are not yet fully equipped to carry on the work for their respective region. Work for the central Rocky Mountain region, formerly centering at Colorado Springs, was practically discontinued for lack of funds.

How great the need is for vigorous attack upon the problems that research must solve in the East has already been pointed out. But western needs must not be forgotten. The problems with which the Forest Service is confronted in national-forest administration call for better basic knowledge, to make possible full use of the great public forests. And the need to aid private timber growing is likewise great. As a result primarily

of our past mistaken public-land policies an enormous volume of western virgin timber, mostly on land unsuitable for agricultural development yet better suited to growing tree crops than is most of the timberland in the national forests, is awaiting a market. The owners of this timber can not afford to pay taxes and other carrying charges on it indefinitely. Many must cut currently to meet these charges; and the resulting fundamentally unstable condition of the western lumber industry chronically depresses the general market wherever its product competes, and makes the adoption of timber growing in the East more difficult. The earliest possible substitution of permanent forest enterprises based on wise land use for timber mining of the privately-owned western virgin stands, very likely to be followed by land abandonment, is not only of regional but also of national importance.

The natural advantages of large areas of the privately owned western timberlands for permanent forest management are greater than can be found anywhere else in the United States except in portions of the South. The redwood region of California affords perhaps the best natural conditions in the entire country, but much of the Douglas fir region in western Oregon and Washington is not far behind it. Fortunately the bulk of the redwood region is already under plans that contemplate permanent production. A few Douglas fir owners are likewise beginning to apply forestry. Progress, however, throughout the West will be unnecessarily and unduly slow until research has made available a greater body of knowledge on which to base sound and profitable practices. For these reasons, because of the key character of the western situation, and because of the crying need for better knowledge as a guide to good management of the public forests, the early upbuilding of the full complement of western forest experiment stations is essential from the standpoint of national interests.

A research advisory council was organized for the California forest experiment station. Such councils are appointed by the Secretary of Agriculture, and have proved a great help not only in guiding the Forest Service attack upon regional problems but also in correlating forest research by many agencies and in developing sound general regional policies. Councils previously appointed function for the Appalachian, Lake State, Southern, North-

east, and Pacific Northwest regions. They comprise representatives of such interests as the lumber and wood-using industries, forest schools, State foresters and forestry associations, agriculture, mining, banking, public utilities, and scientific organizations. Some 15 or 20 members appointed for terms of from one to four years make up a council.

The assignment of forest entomologists and forest pathologists to forest experiment stations by the Bureau of Entomology and Plant Industry was continued, with an increase of one entomologist, assigned to the California station. During the coming year two additional pathologists will be assigned to the southern station. The forest entomologists are studying at the northeastern station the white-pine weevil and the spruce-bud worm, and at the California and Appalachian stations bark beetles; the forest pathologists, located at the Appalachian and the northeastern stations, the diseases of forest trees and the decay of slash. Forest fire weather investigations are closely tied in with similar investigations by the Weather Bureau, particularly in the Pacific coast, Northern Rocky Mountain, Lake State, and Northeastern regions. Cooperative wild-life investigations are being made by the Bureau of Biological Survey, with valuable results; and plans are under way for the assignment of forest biologists to the forest experiment stations, the first station to which a biologist will be assigned being the California station.

In carrying out their programs the forest experiment stations cooperated closely with the State foresters and other forestry organizations in every region. The State forester of California is participating in a study of erosion and stream flow, and in other investigations, and the State forester of Louisiana in a survey of southern hardwood bottom lands. In Pennsylvania, Virginia, Texas, and elsewhere the State foresters assisted in the collection of field data, and in Michigan and Wisconsin the State departments are cooperating in fire and growth studies. Many forest schools also work in close cooperation with the forest experiment stations.

To aid and supplement the investigations conducted at the forest and range experiment stations, a silvicultural section was organized at the forest products laboratory, where will be concentrated much of the research on such matters as the relation of wood

structure and wood properties to tree physiology and to growing conditions, forest-tree morphology and physiology, and the influence of light on forest growth. These subjects present many important problems in which the preliminary work on technic and equipment can best be carried on at the laboratory.

The research program comprises both general and purely regional projects. The most important examples of the former are (1) a series of studies to determine growth capacity, or in other words what wood return can be expected from a given piece of forest land anywhere, and (2) a series to determine what, broadly speaking, are the silvicultural practices necessary to keep forest lands everywhere fully productive.

Naturally, both call for regional subprojects. The growth capacity of forest land and also the silvicultural practices that will make best use of it vary with the forest region and type. Of the growth-capacity studies several are nearing completion, and yield tables are now available to timberland owners and foresters for the four southern pines, spruce in the Northeast, Douglas fir in the Pacific Northwest, western white pine in the northern Rocky Mountains, yellow poplar in the Appalachian region, and the southern white cedar of the eastern coast. With the establishment of the Central States and Allegheny stations it has become possible to devote more time to the study of the northern and interior oaks, begun on a small scale several years ago, and to expand it to the entire range of the more important eastern oaks. Because of the mixture of species in the eastern hardwood forest, and since the purpose of the study is to show the entire yield obtainable from such mixtures, it is necessary to determine the growth rate of practically all the commercial hardwood species in the East. This involves the construction of over 200 volume tables. The study when completed will be a monumental piece of work.

A number of the studies to determine the desirable silvicultural practices have likewise been completed, and publications covering five of them have been issued. They cover the California pine region, the Douglas fir region of the Pacific Northwest, the hardwood region of the Central States, the western white pine and larch-fir forests of the northern Rocky Moun-

tains, and—the most recent—the Lake States region. Other reports in this series now in various stages of preparation are for the southern pine region, the central Rocky Mountains, and the Northeast, and for western yellow pine, both north and south. Each report outlines the measures which the timberland owner should adopt to grow and protect valuable timber crops.

Examples of purely regional problems under investigation are the proper management of mixed spruce and hardwood forest in the Northeast, and of the hardwoods of the Appalachian region, which supplies much of our hardwood lumber; in the Lake States, the group of problems created by the fact that there are millions of acres of unproductive or only partially productive cut-over land (a situation that is resulting in a widespread demand for information on methods of converting scrub land into productive forest), and the relation of drainage to swamp-forest growth; in the southern pine region, the development of methods of turpentineing that will best fit the requirements of forest management; in the northern Rocky Mountain region, blister-rust control; in the intermountain region, the development of cutting methods to insure natural reproduction in the shortest possible time; and in California, very difficult and important problems of fire control and the relationship between cover and water supplies.

The swamp forests of northern Michigan, Wisconsin, and Minnesota occupy some 9,000,000 acres. In their present condition many of them are almost valueless for production. A typical black spruce swamp, for instance, grows only about one-tenth of a cord of wood per acre per year. Yet in northern Europe hundreds of thousands of acres of such land have been made into profitable forests. Experiments of the Lake States Forest Experiment Station begun several years ago are now showing that suitable drainage causes an immediate increase in growth. In northern Minnesota the removal of excess water has increased the diameter growth from two and one-half to three times, the height growth from two to seven times, and the volume growth from twelve to twenty-three times. The increase is considerably less in hardwood trees such as birch and aspen, than in spruce, tamarack, and other conifers which have more superficial root systems. Drainage also makes the top

soil more suitable for tree-seed germination. Further study of the effect of drainage is under way.

A branch station of the Southern Forest Experiment Station is located at Starke, Fla., for the study of problems relating to naval-stores extraction. Second-growth slash and long-leaf pine stands have been worked for turpentine by different methods. Under conservative methods of chipping relatively slight injury is done the tree, and over a period of years more resin is obtained. On 1,212 trees conservatively worked the most recent results show an annual mortality from turpentine of only about 0.4 per cent. In a group of 600 slash pine trees worked lightly—i. e., with but one face to a tree, relatively narrow faces, and streaks of moderate and uniform depth and width—a 4-year experiment just concluded shows a loss due to the chipping of only 0.2 per cent of the trees annually as against 8 per cent, or forty times as many, in a similar adjoining group heavily worked.

For a number of years there has been under way in California a study of the effect of different cutting methods upon the rate at which natural reproduction becomes established. In connection with this study over 20,000 trees have been remeasured at five-year intervals. A recent analysis of these measurements developed a new classification of the trees in the western pine forests. It appeared that certain classes of trees, readily recognizable in the forest, are especially subject to insect attack; others are liable to windthrow or breakage, while still others make too poor growth to be worth retaining in the forest. This discovery has made it possible to select trees for cutting far more discriminatingly, and it has found general application on the national forests of the California pine region. The simplicity of the method makes the checking of marking practices on timber-sale areas easy and more systematic. Study of this method in relation to other stands bids fair to revolutionize practices in marking timber for cutting on national forests elsewhere.

Other investigations which can be only briefly touched upon include the proper management of southern California chaparral forests to prevent erosion and rapid run-off; the distance to which wind carries the seed of various conifers; the damage done by forest fires to stands of various ages; methods of thinning young

stands to increase their productivity; damage to wood lots through overgrazing; and methods of cutting in various forest types to insure rapid restocking of the forest tree species. An investigation of the fertilizing value of forest-leaf litter, just concluded by the Lake States Forest Experiment Station, showed that in white, red, and jack pine forests approximately a ton of needles per acre falls to the ground each year, the amount varying for stands of different kinds and ages from 1,847 pounds for old-growth red and white pine to 2,375 pounds for young jack pine. In addition to considerable quantities of calcium, phosphorus, and potassium the needles falling in a year on 1 acre contain an amount of nitrogen equal to that in 70 pounds of sodium nitrate fertilizer, costing commercially about \$3. A forest fire in that region usually consumes the accumulated litter of several years.

In cooperation with the State of Minnesota, the Lake States Forest Experiment Station issued a publication on the forest fires in that State following the completion of a statistical analysis of all the fires reported to the State forester for many years. The station also prepared a manual on planting practice based on extensive observations and investigations throughout the Lake States and southern Canada. This is being distributed in preliminary form pending publication. Planting and nursery research has been under way at several of the other stations, particularly at the Southern. Slash pine, now a favored species in the South because of its exceedingly rapid growth, has been found not well adapted to upland sites, since on the flat lands on which it naturally grows about 10 per cent greater survival and a 30 per cent better height growth was obtained. Root pruning long-leaf pine seedlings before they are planted apparently does not, as was formerly believed, stunt the development of these trees, but on the contrary appears to stimulate to some extent the height growth.

FOREST-PRODUCTS INVESTIGATIONS

Research at the Forest Products Laboratory seeks mainly to provide forest products of definite, unvarying quality, and to extend their supply through more scientific utilization.

Quality control is being carried back to the formation of wood in the forest. It may prove possible to grow trees for specific properties. Experiments dur-

ing the year concerned the southern pines, and density control. An experiment on the Florida National Forest now in its third year, and studies of artificial thinning elsewhere in the southern pine region, prove that density is controllable within limits. Density was chosen as the first subject of these studies because it is a fairly reliable indicator of many other wood properties, such as strength, hardness, and ease of seasoning. Apparently the size of the leafy crown of the tree determines the amount of light wood formed in the spring, while the moisture and fertility of the soil determine the amount of denser wood formed later in the year. Observations on young redwood stands in California show that the spacing of the trees produces a much greater effect on the density of the wood than does the soil composition. From the standpoint of forestry practice, better knowledge of the effect of controlled growth conditions on the structure and properties of all the important commercial species of wood is needed.

More immediate results in enabling wood to meet the need of industry for materials of known uniform properties are being sought through the development of better methods of grading and selecting lumber. The laboratory is determining the characteristic defects which occur in each of the various commercial softwoods, so that the present standard grades for softwoods may be more effectively differentiated. This study, begun last year on the southern pines, is being extended to the western softwoods at the request of the lumber industry. Study of structural columns of Douglas fir and southern yellow pine afforded new data on the relationship between defects and the strength of wood columns of various lengths, permitting the preparation of more efficient grading rules for structural posts and columns and the application of a new and more efficient formula to column design. The results of the column study and of previous work on structural timbers were embodied in the standard specification for posts and square timbers adopted last year by the American Society for Testing Materials. A similar specification had previously been adopted by the American Railway Association.

Preparatory to a further important refinement in lumber grading, that of grading lumber according to its degree of dryness, the laboratory in cooperation with the lumber manufacturers in the principal softwood regions of

the United States made extensive tests of the moisture content of all grades of softwood lumber as it is shipped. The information obtained was made the basis, by the central committee on American lumber standards, of definite seasoning grades to apply to all softwood lumber. The recommended grades were considered by the seventh general conference on lumber standards held in Washington, May 3, 1928, and final action by the trade upon them is expected in the course of the year.

Trade use of moisture grades depends largely upon the means available for measuring moisture content. The only method in common use is to oven-dry samples cut from selected boards and determine their loss in weight. This method is far too slow, cumbersome, and inconclusive to be satisfactory. The laboratory has been working on rapid methods of determining the moisture content of lumber, and during the year developed two instruments to the point of readiness for commercial trial. One is a small thermometerlike instrument which, when inserted in a hole bored in the wood, will give a reading of moisture content in a few minutes. The other is an electrical-resistance instrument which makes possible a practically instantaneous determination of moisture content. Further developments of the latter type of instrument may lead to an automatic apparatus which will test the moisture content of each board as it is being graded at the mill. The possible refinements in wood utilization through more scientific grading and selection are evident when it is realized that in any lot of lumber as now graded one board may be half as strong as another, shrink and swell twice as much, be half as resistant to decay, wear half as long, or be only half as good an insulator against heat losses.

Deficiencies in certain properties may be detrimental in one use but not in another. Hence an essential part of scientific grading is a knowledge of use requirements. Very little research has been done towards analyzing use requirements in terms of wood properties. Wood of high strength is often wastefully used where strength is of no importance; soft pieces are used where only hard pieces will withstand the wear, and so on. During the year the Forest Products Laboratory formulated plans for the investigation of certain important use requirements as funds permit, for example, the permissible range of moisture content of

wood in various house parts, the decay hazards in buildings in various regions, and the transportation hazards which shipping boxes and crates must be designed to meet. Preliminary tests of the moisture requirements in wood stock for door manufacture made available better knowledge of the moisture limits within which such troubles as opening joints, sticking doors, and lock misalignment may be avoided.

While scientific selection of wood for a given use presupposes a full knowledge of all its properties, only on the strength properties are nearly adequate data as yet in existence. They are the result of recently completed tests on 500,000 specimens of the several hundred commercial species of wood in the United States. The laboratory is now engaged in a study of the variation in strength found within each species and producing region. This will be of great aid to wood users in their choice of species and design of products. Comparable data are lacking on some 30 other properties of commercial importance.

In the field of the chemical composition of wood, the progress in the study of wood extractives, or portions soluble in water and other liquids, illustrate the practical results obtainable. The study has been hitherto principally of the extractives in redwood. They apparently have considerable effect on the strength properties of that wood, and probably account for its high decay resistance. Drying the wood decreases the solubility of the extractives—which suggests a means of avoiding the troublesome discoloration of paint coatings on redwood. A new compound, "sequoyite," has been isolated from redwood extractives, whose properties remain to be studied.

Combined chemical and microscopic studies have disclosed some interesting details in the structure of the cell wall in wood. The inner walls of the cell are made up of fibers running mostly longitudinally, but of a slight spiral arrangement. The outside layer, however, is made up of a contiguous band wound around the cell. Knowledge of this cell structure is of great value in explaining the shrinkage and strength properties of the wood. In all probability the discoveries made in the cell-structure studies will find direct application in the development of maximum strength properties in wood pulps, and in the improvement of formation and strength in the resulting commercial papers. They should also

help to explain the movement of liquids in wood, upon the rate and extent of which depend the practical operations of drying and impregnating.

Artificial treatment affords a further control of the properties of wood. The laboratory continued its experiments in treatment against decay. The work of the year related to the treating of certain refractory species for use as railroad ties, the toxicity of various preservative chemicals, notably the arsenic compounds, and the preservative treatment of building lumber with zinc chloride. Experiments with various commercial fireproofing treatments are planned.

The production of treated wood for general purposes raises new questions regarding such matters as the painting and finishing characteristics, strength, and moisture-absorptive qualities of such woods. Studies to determine the fitness for building purposes of lumber treated with zinc chloride are now in progress.

Satisfactory results in the use of wood depend not only on the wood but also on the accessory material. This is particularly true of paints. Considerable effort was given to adapting paint coatings to various woods. Development of a paint coating that will adhere to dense summerwood, especially of flat-grain boards, was sought. Its discovery, when accomplished, will greatly reduce repainting costs on house siding and trim. Another accessory material under investigation is glue. Improved practices in the gluing of various woods, developed at the laboratory, are reported in a handbook for the trade, now being published. Present research is being centered on making glues that are more durable.

Extension of the supply of forest products can be effected through the reduction of waste in manufacture, through increased yields, and through the modification of manufacturing processes to utilize new species.

Whether it pays to cut small trees, or to leave them for a subsequent cut, can be told only through systematic investigation of a whole series of problems concerning both utilization and forest management. The Forest Products Laboratory cooperated last year in a Forest Service study of such problems in connection with small mill operations in the Arkansas short-leaf pine region. Sound utilization standards are essential both for private enterprises seeking a sustained yield and for the Forest Service in its administration of the national forests in

Arkansas. Information was obtained by size classes on logging and milling costs, on the grades of lumber produced, and on the benefits of certain operating practices.

It was found that on the type of operations studied short-leaf pine trees less than 11 inches in diameter breast high do not pay their way; that fire-damaged short-leaf pine logs brought \$10.20 less per thousand feet gross scale than sound logs of the same size and position in the tree; and that careful sawing and improved operating methods produced from a given quantity of logs at least 13 per cent more lumber, worth \$2.64 more per thousand feet, than is customarily obtained. These and other results derived from the study typify the kind of information obtainable, and basic to profitable forest operations.

As a follow-up of similar logging and milling work done the previous year in the hemlock-hardwood region of the Lake States, a study was carried on to determine how utilization standards would be modified if small logs and the material in mill trimmings, edgings, and slabs were cut into dimension stock. Preliminary results indicate that much of the waste material can thus be profitably salvaged. A start was made in determining the costs of the different recognized methods of dimension stock production.

Tests to determine the suitability for boxes of certain little-used species of wood which must be logged along with more valuable woods indicated a probable use for such material in the form of low-grade thin veneer, in wire-bound boxes. The wire-bound box has generally been manufactured from clear, high-grade veneer.

A microscopic study of burned and unburned young long-leaf pine trees afforded for the first time detailed information on the injury from annual burnings prior to turpentineing. The tissues of trees which had their foliage completely scorched off in late winter, but were not killed and put out new leaves, in comparison with similar trees of uninjured foliage, showed a great depletion of reserves, retarded early growth, and an excessively reduced wood and resin tissue formation throughout the year. Their yield of naval stores was 50 per cent less than that of the uninjured trees, and in spite of the recognized hardiness of the species, by the beginning of the second year of turpentineing 50 per cent of the scorched trees were either dead or no longer yielding gum.

The pulp and paper studies deal mainly with the problem of extending the supply of raw material through increased utilization of abundant species, more complete utilization of pulpwood at the mill, and the utilization of timber wastes. The southern pines and southern and northern hardwoods were the important species studied for increased utilization. Strong white pulp has been produced semicommercially from the southern pines by means of a modified sulphate pulping method and a combined chlorine gas and hypochlorite bleaching. The indications are that such a pulp can be used successfully in the manufacture of writing, bond, and ledger papers. The next step is to duplicate commercial grades, using the laboratory equipment. Sulphate-pulp studies upon hardwoods showed that papers of catalogue and print quality can be produced, at an estimated cost comparing favorably with that in commercial practice, from furnishes of hardwood sulphite and hardwood mechanical pulps containing a small admixture of long-fibered sulphite, in place of the usual furnish made entirely of softwood fibers. Further mill-scale trials will be arranged.

Under the semichemical mild neutral pulping process, Lake State aspen, birch, and maple can be cooked together and milled to produce remarkably strong pulps in high yield for the cheaper papers and board. Satisfactory sulphite pulps, both bleached and unbleached, apparently suitable for use in high-grade book, bond, and writing papers, have been produced from the same species, alone and in admixture with northern conifers.

More complete pulp-wood utilization will take place if as much of the wood substance can be left in the pulp as the use requirements will permit. This has been done in the semikraft and semichemical processes and application is now being made of the same principles to the sulphite process, with the result that yields of from 65 to 80 per cent of the wood substance have been obtained as against the 40 to 50 per cent obtained by the ordinary sulphite process. This production has been substituted experimentally for standard sulphite in print and other cheap papers.

The cooperative studies of the profitable utilization for pulp of timber waste, both sawmill and manufacturing, were continued with various agencies. For example, the possibility

of producing sulphate pulp from the extracted chips which are by-products of the rosin industry in the South was investigated, and medium-grade pulps entirely suitable for use in the production of boards and the cheaper grades of wrapping papers were obtained. Rod-milling studies have been carried far enough to show that the results can be varied at will through wide ranges for particular papers from given pulps, by the design of the milling elements, and results can be produced which, so far as is known, are not capable of duplication by other means.

The results of an extensive study of air-seasoning methods in the West were brought together in report form, and are now in process of publication. With better methods losses both in quantity and quality of western softwood lumber can be reduced, the average drying time can be shortened, shipping weights can be lowered, and final moisture-content requirements can be more nearly attained. The publication discusses the results from present air-seasoning practice in the principal producing regions, and presents the general principles involved and their application to yard drying. Air-seasoning rules applicable equally to all yards can not be laid down, since the conditions vary; but certain fundamental information can be applied to work out the effect of different methods and combinations of methods upon stock depreciation, rate of drying, etc., with the prospect of worth-while financial returns through improved practice in such things as drainage in the yards, space between piles, foundations for and construction of piles, and space between boards in a course.

The results of an extensive series of sawmill studies in the "inland empire" were published as trade-journal articles, showing that closer utilization in varying degrees is entirely practicable by closer attention to mechanical factors, sawing methods, the training of workmen, and the adoption of lumber standards. Taper sawing was found to be preferable to the common practice of sawing parallel to the center line of the log. In some eight mills the best method of taper sawing showed \$11.02 higher profit per thousand feet, net log scale. Another comprehensive study showed the relation of size and defect in the important tree species of the region to the production cost and the value of the lumber. The extensive detailed tables resulting from the study offer a prac-

tical method of estimating costs and values in any specific operation.

The San Francisco Bay piling committee, made up of a group of organizations including the San Francisco office of forest products of the Forest Service and the Forest Products Laboratory of the Forest Service, published a report entitled "Marine Borers and Their Relation to Marine Construction on the Pacific Coast," embodying the results of the most intensive and comprehensive study of marine borers ever made, together with service records on some 200,000 piles in San Francisco Bay and a discussion of a large number of preservatives and processes for protecting piling.

FOREST-ECONOMICS INVESTIGATIONS

The forest-taxation inquiry field work in Minnesota and Wisconsin was practically finished and compilation of the results is well along. The Wisconsin work was largely in cooperation with the College of Agriculture of the University of Wisconsin, and the Michigan work drew heavily upon the data of the Michigan land economic survey. Plans were made and preliminary office work was begun for extending the inquiry to New England. The principal efforts of the current year, however, will be concentrated upon the Pacific Northwest, particularly Oregon. The forest-taxation problem in that region is especially urgent. Because the forests consist so largely of mature timber the problem differs from that in any portion of the East, where tax reform has to do chiefly with young, growing forests. Adjustment of taxation in the Northwest may be an important factor in prolonging our supply of large timber.

Two progress reports making available some of the results of the inquiry were issued. A digest of the various State forest tax laws, primarily for the use of the staff of the inquiry, and abstracts of these laws and a preliminary bibliography on forest taxation, intended for general use, have been prepared. Work was begun on a historical study of forest-tax legislation, and advisory assistance was given Minnesota, West Virginia, and North Carolina.

A study to ascertain under what conditions and to what extent marginal and submarginal agricultural land in southeastern West Virginia can be utilized for growing timber, and to investigate the place of forestry in the

agricultural economy of the region, was undertaken in cooperation with the Bureau of Agricultural Economics and State agencies. Endeavor was made to get at some of the underlying economic factors, such as the cost of holding land for forestry, the prospective markets for forest products, and the quantities and kinds of products that the land will yield.

Cooperation continued with the Bureau of the Census in gathering statistics on the production of lumber, lath, shingles, and other forest materials in the Western States. The reports on lumber distribution gathered in 1927 were compiled into tables showing the estimated shipments of softwoods and hardwoods from each State to every other State, and the amounts reported. This is the fifth year that the collection of such data has been made. It was found that the per capita lumber consumption in 1926 varied from 1,230 feet, board measure, in Oregon, to 100 feet in South Carolina, while the average for the United States was 300. It is proposed to expand this project in 1928, so as to show the principal sources and destinations of lumber exports. Under a proposed cooperative arrangement with the Dominion Bureau of Statistics of Canada, it will be possible to show in considerable detail the lumber distribution and consumption in all parts of North America north of the Rio Grande.

A bulletin was completed and published embodying the latest and most authoritative statistics on American forest resources, forest administration, and forest products, and was in such request that a second and third printing were necessary. The demand for reliable information on our timber supplies and requirements is becoming more and more insistent. Two popular publications outlining the situation were issued during the year, but complete information can not be given until a comprehensive forest survey of the whole country can be made, such as is contemplated by the McSweeney-McNary law.

The growing interest of private owners in forestry was evidenced by the commercial forestry conference, held under the auspices of the Chamber of Commerce of the United States at Chicago in November, 1927, and the Wisconsin commercial forestry conference, held at Milwaukee in March, 1928. Private forestry, however, to a much greater extent than public forestry, depends upon full

knowledge of the economic forces which affect the growing, harvesting, merchandising, and utilizing of timber crops. Regarding these, and the public measures that will bring about the most favorable conditions for private timber growing, there is much to learn.

RANGE INVESTIGATIONS

Approximately 70 per cent of all the feed for livestock in the 11 far Western States comes from range land, and range livestock production is one of the most important industries of these States. For stable and profitable production it is essential to know how much, during what period, and by what kind of livestock each individual range can be grazed without loss of carrying capacity.

Forest Service range research now largely centers at an experiment station in the mountains of central Utah and at two range reserves on the semidesert low ranges of the Southwest. In the late nineties, the high mountain watersheds of Utah, according to stockmen, were practically dust beds. Not only were they failing to furnish satisfactory feed supply for the livestock, but the soil was washing away and disastrous floods were doing damage to the valley farm and urban properties. Fifteen years of study have shown that on these ranges satisfactory and valuable forage crops can be reestablished, which will also reduce the floods and erosion and afford better water flows.

During the first 10 years the improvement was slower than during the last 5, after improved soil conditions and an increased stand of grasses had been brought about. The greatest increase took place where the grass had not been completely killed out. On the better soil areas, with a few grass plants still left under the protection of brush, only 2½ acres is now required to support a cow a month, against 10 acres or more in 1912. The improvement has been accomplished largely by adjusting the degree and time of grazing to the requirements of the more valuable forage plants.

The studies have shown that total protection from grazing does not maintain, as might be assumed, the most satisfactory stand of vegetation over a period of years. Totally protected vegetation becomes dense in good years but may be materially thinned in a dry year. Grazing tends to keep the clumps of grasses smaller, at

when drouth comes the vegetation appears to be better able to withstand the deficiency of soil moisture.

Where the valuable plants have been practically eliminated their reestablishment is apt to be very slow. Artificial reseedling with cultivated forage plants has shown that Kentucky bluegrass, common or smooth brome, timothy, and sweet clover have considerable promise. The results of the studies in this field were summarized last year for publication.

Among the native species, violet wheat grass and mountain brome are giving notable results. The forage value of experimental areas has been increased from six to ten times by seeding these plants. Stockmen on the Manti National Forest, on which the Great Basin Experiment Station is located, have become so impressed with the results that practically all the livestock owners and herders are co-operating to revegetate depleted areas. They collect seed of the valuable forage plants in connection with their regular work—some only in small amounts, now and then; but others have stripped ripened seed from the more valuable plants by the sackful and scattered it on depleted areas. With from 150 to 200 men collecting and planting seed each year, marked progress is being made in revegetating such areas, at a practically negligible cost.

Intensive studies are badly needed on the intermediate and lower elevations of the intermountain region. The spring range situation at the lower elevations is especially critical. Although in early spring practically no forage grown the year before remains to be eaten, livestock are placed on the range before the plants have produced new feed. This both delays the development of the forage and lessens the quantity produced. The lack is reflected in decreased livestock production. Insufficient nourishment of ewes during lambing results in the death of thousands of lambs annually and the stunting of many more. Cattle ordinarily come out of the winter in poor condition, and when turned loose on spring range bearing little feed, and that very watery, not only do they fail to make gains, but many die of starvation.

About 150,000,000 acres of western range suitable for spring grazing is in poor condition. Because of this there is an urgent demand for too early use of at least 25,000,000 acres of national forest ranges on which productivity is already low in consequence of prema-

ture grazing. The problem calls for intensive study throughout the West, but the need is particularly urgent on the low ranges of the intermountain region. The winter range problem is likewise becoming more and more critical in this region. The better forage plants have largely been destroyed, and many ewes die yearly of malnutrition or from eating poisonous plants because of an inadequate food supply. A much better understanding of the form of management most desirable for all types of range and a sound basis for correlating their use is essential.

Among the current investigative projects continued during the year at the Great Basin Experiment Station were studies of natural revegetation, periods of plant growth and use, plant vigor, cell sap, spring-fall range management (in cooperation with the Bureau of Animal Industry), and the correlation of the principal climatic factors with plant development.

In the Southwest 13 years of study has now been given by the Forest Service to management of the semi-desert cattle ranges, which are used yearlong. The Jornada Range Reserve is in southern New Mexico. It was fenced in 1912, under the direction of the Bureau of Plant Industry. At that time it was typical open public domain range. Since fencing it has been conservatively grazed. By 1916 on the part reserved for fall, winter, and spring use the density of valuable grasses was four times that found on the adjoining open range. The region is subject, however, to severe periodic droughts. One was experienced from the summer of 1916 to the winter of 1918-19, and another from the summer of 1921 to the winter of 1925-26. By 1924 the valuable forage plants on the reserve had decreased to slightly less than one-third the maximum density attained during the period, and on the open range to 6.75 per cent of the maximum.

In 1925 most of the cattle were removed from the main portion of the reserve for that year. In 1927, following two good years of growth, the reserve range was almost back to its maximum; but the open range, although practically ungrazed in those two years, had failed to recover noticeably and was occupied mainly by worthless, poisonous, or low-value vegetation. Even under drought conditions, except during the year of disuse the reserve has afforded satisfactory cattle production. The average calf crop for the 9-year period 1915-

1924, which included seven years of drought, was 65 per cent, and the average loss was only 1.8 per cent, a net production of 63 animals for each 100 cows grazed. On the adjoining public-domain range the average calf crop was 50 per cent and the loss about 10 per cent, or a net production of 40 head per 100 cows. Thus the reserve produced 57½ per cent more calves per 100 cows than did the open range. And the reserve cattle sold for from \$2 to \$12 more per head than the outside cattle of the same age and class.

On the Santa Rita Range Reserve, in southern Arizona, the experiments have shown that it ordinarily requires from three to five years of careful grazing, or total protection from grazing, to restore a moderately depleted grama range, and considerably longer if the grama and other valuable grasses have been killed out. The experiments also indicate that a semi-desert grama range can be maintained in as good condition with proper grazing as with total protection, if not better. The essential matter is a plan of management which allows the forage plants to make satisfactory growth during about six weeks of the summer rainy period, when nearly all the year's supply of feed is produced.

It is also essential to stock the range on a basis which will allow the breeding herd to be maintained in a dry year. By utilizing approximately 80 per cent of the forage in the average year and by providing reserve pastures for the critical spring period the breeding herd has been maintained throughout the 13-year period. The range is now in excellent condition.

On the open range the number of cattle varied greatly during the period, but the average was much lower than that for an equal area of the reserve. Yet the open range is now badly depleted, and the valuable grasses start growth about three weeks later, both in the spring and summer, than on the conservatively grazed range. The average annual calf crop from 1916 to 1925 on the reserve was 73 per cent and the loss less than 4 per cent, and the cost of the average yearling on the basis of 1925 values was \$17 a head. In representative outside open-range outfits the calf crop averaged only 53 per cent, the loss averaged 10 per cent, and on the basis of 1925 values the average cost of yearlings was \$22 a head. The fat yearlings from the reserve sold for \$4 more a head and netted as of 1925, when prices were

generally unsatisfactory, 7.4 per cent on an investment of \$85 per cow, compared to a loss of 5.8 per cent on investment of \$55 per cow on the open range.

Similar intensive studies are being needed on the mountain ranges with the national forests of the Southwest. Drought and overstocking of the higher-elevation ranges have resulted in depletion of forage plants, injury to timber production and to watershed protection values, and uncertain profits to the livestock business.

During the year intensive studies of the grazing and timber-production problem were undertaken on one sheep and one cattle range within the yellow-pine timber type on the Coconino National Forest, in cooperation with stockmen. Additional ranges and number of pastures will be studied to determine the amount and character of injury to yellow-pine reproduction from varying intensities and periods of grazing use over a term of years.

The great loss which the West is suffering from soil erosion on western grazing lands was presented in part of Circular 33 of the Department of Agriculture, *Soil Erosion a National Menace*, published during the year. Damage from floods, reduction in the capacity of irrigation and other reservoirs, and reduction in the productivity of range lands constitute a significant problem. Of outstanding importance for correcting the situation are the reestablishing of the vegetative cover on the ranges, regulated grazing on the unreserved public lands, protection of the vegetative cover against fire, and erosion control by artificial means. Corrective action must be taken so that if far greater damage and increased difficulty of control are to be obviated.

During the year effort was made to present the results of experiments to those who would have greatest interest in them, through articles published in the livestock journals and the department press, and directly to the stockmen at the Great Basin Experiment Station field day in the fall of 1927, when approximately 200 stockmen showed great interest in the results so far obtained. Interest in increasing the productivity of range lands and assuring an adequate supply of feed for profitable livestock production was particularly keen. The stockmen's attendance urged an extension of the investigations to other parts of the intermountain region, and especially the spring, fall, and winter ranges.

EXPENDITURES AND RECEIPTS

The expenditures for all purposes during the fiscal year were as follows:

General administration-----	\$373, 132. 28
Protection of the national forests:	
Fire protection and de-	
tection-----	1, 872, 810. 21
Fire suppression-----	962, 947. 47
Protection against in-	
sects and tree di-	
seases-----	159, 763. 72
Total-----	2, 995, 521. 40
Administration of current business on the national forests:	
Administration of tim-	
ber use-----	1, 124, 336. 98
Administration of graz-	
ing use-----	972, 574. 30
Fish and game pro-	
tection-----	119, 420. 06
Administration of re-	
creation and land use-----	215, 183. 52
Examination and ad-	
ministration of power	
sites for Federal	
Power Commission	
and support of its	
personnel-----	36, 824. 62
Total-----	2, 468, 339. 48
Surveys of lands and re-	
sources:	
General surveys and	
maps-----	161, 760. 94
Grazing reconnais-	
sance-----	119, 512. 28
Timber surveys-----	280, 391. 91
Total-----	561, 665. 13
Land adjustment and ex-	
tensions:	
Classification, settle-	
ment, and claims--	81, 838. 15
Land exchanges-----	131, 630. 51
Acquisition under act	
of March 1, 1911, as	
amended-----	1, 999, 842. 78
Total-----	2, 213, 311. 44
Nurseries and tree planting--	192, 907. 45
Tree planting in cooperation	
with States under act of	
June 7, 1924-----	74, 976. 98
Construction and mainte-	
nance of improvements:	
Construction of im-	
provements other	
than roads, trails,	
and camp-ground im-	
provements-----	822, 350. 67
Maintenance of im-	
provements other	
than roads, trails,	
and camp-ground im-	
provements-----	690, 575. 23
Camp-ground improve-	
ments-----	42, 517. 00
Total-----	1, 555, 742. 90
Research:	
Silvical investigations--	433, 974. 93
Forest-products investi-	
gations-----	573, 702. 24

Research—Continued.	
Range investigations--	\$83, 302. 15
Taxation study-----	48, 665. 00
Total-----	1, 139, 644. 32
Fire protection in coopera-	
tion with States under	
act of June 7, 1924-----	942, 448. 77
Protection of Oregon and	
California grant lands--	60, 041. 56
Forestry extension-----	39, 570. 89
Road and trail construc-	
tion and maintenance:	
10 per cent fund under	
act of Mar. 4, 1913--	666, 704. 79
Cooperative construc-	
tion of roads and	
trails under act of	
July 11, 1916-----	339, 531. 31
Federal forest-road	
construction under	
act of February 28,	
1919-----	31, 125. 36
Forest development	
roads and trails un-	
der act of Nov. 9,	
1921-----	3, 028, 179. 03
Forest highways under	
act of Nov. 9, 1921--	4, 504, 864. 96
Road and trail con-	
struction from mon-	
eys contributed by	
cooperating agencies	
under act of June	
30, 1914-----	979, 710. 79
Contributed from	
other appropriations--	490, 035. 99
Total-----	10, 040, 152. 23
Grand total-----	22, 657, 454. 83

In addition to the expenditure for land extension itemized above in the entries "land exchanges" and "acquisition under act of March 1, 1911," national forest timber having an estimated value of \$267,036 was cut under agreements involving the acquisition of land and timber through exchange. The cash disbursements recorded under "land exchanges" cover merely the outlay incidental to examining lands offered for exchange and appraising the values involved.

The cash receipts from the national forests were as follows:

From the use of timber----	\$3, 325, 079. 24
From the use of forage----	1, 713, 730. 15
From miscellaneous uses, in-	
cluding the use of land,	
water-power sites, etc----	402, 625. 41
Total-----	5, 441, 434. 80

The total is greater by \$274,829.06 than that for the previous year. Receipts from timber increased \$71,836.74. Grazing receipts were greater by \$182,777.69 and miscellaneous use receipts by \$20,214.63.

In addition to the cash receipts from timber there should be credited the value of the timber cut under specific agreements for effecting land exchanges, estimated at \$267,036.

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REPORT OF THE FORESTER

UNITED STATES DEPARTMENT OF AGRICULTURE,

FOREST SERVICE,

Washington, D. C., September 3, 1929.

SIR: I have the honor to transmit herewith the report of the Forest Service for the fiscal year ended June 30, 1929.

Respectfully,

ROBERT Y. STUART,
Forester.

HON. ARTHUR M. HYDE,
Secretary of Agriculture.

THE LUMBER INDUSTRY AND THE FORESTS

Twenty years ago the lumber industry of the United States was virtually at the peak of its expansion. Throughout the nineteenth century the output of the sawmills had risen uninterruptedly from decade to decade. As the century had advanced the rise had accelerated. It had far exceeded the growth in population. As against a consumption of 235 board feet per capita at the middle of the century, at the close was 460 board feet. The total consumption at the middle of the century was less than 5,500,000,000 board feet; at the close, about 500,000,000. And the early years of the twentieth century carried the rise still higher points.

The lumber cut in 1906 was estimated by the Forest Service as 46,000,000,000 board feet; the total consumption as a little over 44,800,000,000 feet; per capita consumption 525 feet. That proved to be the turn of the tide, though it took another decade to establish the fact certainly. The sharp business crisis in the fall of 1907 naturally curtailed production in the following year; but both 1909 and 1910 showed a recovery, and 1912 nearly equaled the 1907 high mark. Not until 1915 did the lumber cut drop below 40,000,000,000 feet. Save in 1916, it never since recrossed that line. In 1917 it fell below 27,000,000,000 feet.

The latest year for which figures are available is 1927. The cut in that year was 34,532,000,000 board feet; the per capita consumption 280 feet.

An equally low per capita consumption has not been shown since 1859, except in the distress year 1921. The 1927 total cut substantially duplicated that at the close of the nineteenth century.

Twenty years ago the public attitude toward forestry, and toward the lumber industry, was largely shaped by two conceptions—that the country's timber supplies were diminishing so rapidly as to make certain an acute shortage before another generation would arrive on the scene, and that a monopolistic control of the remaining virgin timber threatened. Predictions based on the best data available at the time were freely made that if use continued at the then current rate the supplies of saw timber would be exhausted in from 20 to 30 years. It was, of course, not supposed that use would actually continue at an even pace as the forests shrank away—still less that use would continue to grow as it had been growing throughout the previous century of developing industrialism. But it was confidently held that the consequences of timber depletion were presently to become manifest in advancing lumber prices, enforced curtailment of consumption, declining lumber output, markedly enhanced stumpage values,

large speculative gains for timber holders, and widespread public inconvenience and hardship through an increasing shortage of forest products. Further, it was believed that the whip hand soon to be given the lumberman over the consumer by the establishment of a seller's market and by the ownership of a restricted and waning supply of an essential raw material was in imminent danger of gaining new power through the setting up of an artificial control of the market, with a view to further restricting output, raising prices, and increasing profits.

The downward trend of lumber production and consumption since 1907 falls in with the anticipations of that period. Nor is there lacking other evidence to support the view that the country has been steadily advancing toward a time of timber shortage, at least in the matter of saw logs. Many wood-using industries have found it increasingly difficult to obtain the kind and quality of raw material needed to meet their special requirements, or have been made uneasy by uncertainties regarding continued supplies and reasonable price levels. Many of the large-scale lumber operators in the eastern half of the country, and notably in the southern pine belt, have exhausted their stumpage and closed down. The area of cut-over lands on which little or no regrowth of valuable species is taking place and which are not in demand for any other purpose than timber growing continues to enlarge alarmingly. Millions of acres of timberland are cut over annually, with the practical certainty that a large part of the land will eventually come back on the public through tax forfeiture and with the creation of very serious local problems due to the withdrawal of industries, population, capital, and taxable values as the timber gives out. And, finally, there is the certainty that in spite of the decline in lumber production that has taken place in the last two decades, forest depletion is increasing.

In 1920 the Forest Service was called upon by a Senate resolution to report on forest depletion. The report showed an annual drain upon the forests four times the estimated current rate of growth. Of saw timber the utilization and destruction by fire and other agencies was put at more than five and one-half times the growth, and of softwood saw timber at more than six and one-half times. There were then many indications of an approach to

true famine conditions. Spectacular price advances for lumber, newsprint and other forest products were accompanied by acute shortages in the supply of many classes of material and by the inability of some industries to meet their requirements for high-grade material at any price. The report recognized that a combination of speculative and temporary factors was in considerable measure responsible for the extreme conditions then manifest, and it expressly disclaimed for forest depletion a more prominent rôle than that of an important contributing cause. In the light of what has transpired since, however, some of the conclusions then drawn need to be corrected. The predicted timber famine that gave rise to so much concern 20 years ago has not arrived.

Of this, conditions within the lumber industry afford fairly conclusive proof. It has not waxed fat on the expansion of profits of a cornered timber supply. It wears none of the aspects of the triumphant octopus so vividly pictured in former days. It is not overprosperous. Neither through the building up of concentrated ownership of a dominant portion of the remaining timber supply nor through restricted production has anything to inspire fear of a controlled market come into sight. On the contrary, keenly competitive conditions have resulted in a chronic market instability, low profits as a rule, and often in production at an actual loss. The "lumber baron" has ceased to figure much in the popular imagination. His supposed economic power has proved more shadow than substance. The plain fact of the matter is that the lumber industry of the country taken as a whole, would quite naturally increase its output in a very substantial amount, if it could find purchasers willing to take the product off its hands at a reasonably remunerative price. In spite of the great industrial activity of recent years the lumber market has been much more a buyer's than a seller's market. Not a timber famine, but a pressure to liquidate timber holdings that create chronic overproduction, is the outstanding feature of the present situation seen from within the lumber industry.

Last winter the board of directors of the National Lumber Manufacturers Association formally asked that legislation enacted to permit control of production of oil or coal be made applicable to lumber. The objects of control would be price stabilization and conservation of the present stock of timber through the limitation

put. Thus, it was thought, a condition of industrial equilibrium might be established, with more orderly marketing, less waste of material in utilization, longer duration of the present supplies of privately owned timber, better prospects for reforestation, and smoother transition from dependence primarily upon diminishing stores of virgin timber to dependence upon growing forests.

There are both obvious similarities and obvious differences between the present situation of the oil industry and of the lumber industry. In each the conditions which seem impossible control by the industry without the aid of public authority are forcing overproduction. In each case waste of an irreplaceable natural resource is involved—for virgin timber is practically irreplaceable because of the length of time necessary to grow material of the highest quality. In both cases overproduction is due to the fact that these irreplaceable natural resources are temporarily in too abundant supply to permit the establishment of a rational equilibrium between present production and consumption, and between present and future needs. In the case of oil this temporary abundance of supply is chiefly due to the rush to find oil and get it out of the ground before some one else discovers it; in the case of timber, primarily in the financial pressure of rising charges.

The known oil supplies if not supplemented by new discoveries will be exhausted much more quickly than will virgin timber, at the present rate of use. With oil, however, there is possibility of indefinite extension of the supply from fields not now known to exist, to say nothing of what may be obtained from the oil shales, what may be produced from coal. Letting this in the case of lumber be the fact that new supplies can be found. And in addition there is the possibility of substitutes, which to a greater extent with lumber than with oil are disputing its superiority and are ready to take its place as demand enhances its price.

Lumber has to contend with many varied substitutes. One of the reasons for the declining per capita consumption of lumber during the last years has been that people have begun to use other things. In part this has been because of changing customs. Enlargement of transportation facilities has been obtained not by massive railroad building, which re-

quires much lumber, but by multiplying the mileage of improved highways. Rural requirements for new construction have diminished as the expansion of settlement has slowed down, while urban growth, engineering progress, increasing wealth, and new modes of life have combined to enlarge the relative consumption of brick, stone, steel, cement, and many other classes of material that compete with wood. With the depletion of local and regional timber supplies and the consequent inevitable increase in the cost of lumber due to remoteness, more expensive logging, or poorer stands, lumber has been handicapped in its struggle to hold its place and to obtain its share of the new business created by expanding population and industrial activity. It has also had to meet the competition of products made from wood fiber.

Undoubtedly as the supplies of virgin timber become further depleted this latter competition will increase. Research and invention will bring to light new ways of utilizing low-grade material. How extensive our future requirements will be for the kinds of products that in the past the lumber industry has derived from our vast virgin forests it would be rash to predict on the basis of present conditions and present knowledge. Perhaps about all that can be said with entire confidence is that the intrinsic qualities of wood, its relatively low cost of production, and the enormous land area available for growing wood assure it a leading place as a basic raw material for consumption in one form or another. In the same way, of course, it would be unsafe to predict on the basis of present conditions the character and extent of our future requirements for oil or coal.

From the standpoint of the public, two outstanding things are wrong in the lumber industry. High-quality raw material from virgin forests centuries old is being feverishly driven through the sawmills and pressed upon the market, with a large amount of waste of the lower-grade material in the processes of production and with a further waste of the product through its consumption for purposes for which less valuable material would have answered every essential need. In other words, though our original virgin timber is mostly gone, economic conditions have not reached the point at which the remaining stands are being sufficiently husbanded, with due regard to their unique quality and to future requirements. Beyond this, the

pressure to liquidate holdings of virgin timber is operating as a powerful deterrent to the reorganization of our forest economy on the basis of timber growing in place of forest exploitation, and to more rapid progress in establishing right methods of land use.

A single forest region—the Pacific Northwest—is preeminently characterized by the pressure to liquidate. The enormous stores of virgin timber provided in the forests of Washington and Oregon were for a long time grossly underestimated. Even now it is impossible, unfortunately, to give figures that can be regarded as more than rather rough approximations, for no true inventory of our forest resources has ever been obtained, though it is urgently needed. Probably, however, there is still in Washington and Oregon something like 600,000,000,000 board feet of saw timber. Supplementary to this stand as a means of meeting national requirements are another 275,000,000,000 feet in California, and also the heavy forests of northern Idaho and western Montana—to say nothing of the forests north of Washington in British Columbia, from which considerable imports have come into the United States, and our own supplies on the Alaskan coast.

All told, California, Oregon, Washington, Idaho, and Montana have stands estimated to approximate 1,000,000,000,000 board feet, of which somewhat more than half is privately owned. The lumber output of these five States is now about 15,000,000,000 board feet annually. On their face, these figures would seem to show that, even with no allowance for regrowth, cutting can be continued for a good many years at the present rate, or indeed at an increased rate, before the effects would be felt much.

But the ratio of the total estimated stand to current consumption is not the real heart of the matter. Far more important than the aggregate amount of timber is the question of its relative accessibility, on which depends its marketability. Lumbering began in the Pacific Northwest at the very water's edge. With prodigiously heavy stands of timber of the finest quality on land of gentle contours near tidewater, logging and local transportation costs were at a minimum. Naturally, the most accessible timber was the first to pass from public into private ownership, and the first to go to the sawmills. Because of its abundance, stumpage was of low value, and

because of its remoteness from consuming centers the market for manufactured product was limited. Not until the early years of the twentieth century did western Oregon and Washington begin to send lumber in quantity east of the Rocky Mountain States.

As the industry grew it exhausted the stands of greatest accessibility had to go farther back for its timber. Distance and rougher topography combined to increase the costs of operation and transportation. Railroad construction opened up new territory for the lumbermen and there was no longer any stumpage, still low priced—but only a speculative value or none at all. And this process of pushing farther and farther back from the water into and up the mountains, where stands are poorer and logging is more and more difficult, is still going on. In fact, it is still at a relatively early stage. The most inaccessible stands that will be most expensive to log will yield least, are still remote.

In anticipation of the time when timber would be in demand, enormous quantities were speculatively acquired from the United States through misuse of the general land laws. It has not been for the creation of the national forests, the acquisitions which have been still more extensive. The requirements of the lumber industry, however, have not equaled expectations, so that for the last 15 or 20 years there has been an overabundance of stumpage seeking a market, largely escape the pressure of the current charges due to taxes, protection and often interest on indebtedness.

The pressure to liquidate has resulted in plant expansion and has created a condition of market instability and chronic price depression, approaching demoralization. Any improvement in the demand for lumber is the signal for increased production. The result is that the last great reservoir of virgin timber in the United States is being depleted under conditions that involve deplorable waste of raw material and at a more accelerated rate than is in the best public interest—though it has not gone far enough to restore the balance or fast enough to meet the wishes of distressed timber owners—while also acting as a deterrent to the process of readjustment of the lumber industry elsewhere throughout the country to a timber-growing basis.

EFFECTS OF PACIFIC COAST COMPETITION
FOR LUMBER DISPOSAL

one of the evidences of the key position of the far-western forests in the national situation is the volume of Pacific coast lumber moving eastward through the Panama Canal. Prior to 1921 shipments were relatively insignificant in quantity, never having exceeded 10,000,000 board feet except in 1914 and 1915. Between 1921 and 1926 they rose steadily from an initial 207,000,000 feet to a peak of 1,988,912,000 and have remained since 1926 at or near 1,900,000,000 feet. The bulk of the supply has come from Washington, whose mills 72 per cent of the 1928 shipment of 1,964,221,000 board feet (including nearly 300,000 feet from British Columbia) was sawed.

Approximately two-fifths of the 1928 shipments entered the port of New York; and by far the leading wood has been Douglas fir. Between Douglas fir and southern pine a sharp competitive struggle has gone on in the New York and other eastern markets during the few years. Prices have been unstable to a degree that has tended to dislocate the distributive mechanism and interfere with orderly marketing. Undoubtedly but for the fir cargoes, the coming down of many of the large southern mills that has been taking place as their supplies of stumpage have failed and the fast-approaching exhaustion of the virgin stands of softwoods in the South would have been expected in quite different market conditions.

Together, the cut of these two leading softwoods, southern pine and Douglas fir, formed, in 1928, 70 per cent of the total softwood cut of the United States, and 56 per cent of the cut of woods and hardwoods combined. The cut of southern pine in the last six years has averaged approximately 10,000,000 board feet per year; of Douglas fir, 8,250,000,000 board feet. In 1923 Douglas fir made up 39 per cent of their combined cut; in 1928, 44 per cent. Their average prices at the mill for the few years, as compiled by the Forest Service, have dropped from \$28.93 per thousand feet for Douglas fir and \$31 for southern pine in 1923 to \$21 for Douglas fir and \$25.32 for southern pine in 1928.

In brief, the main competitive influence upon softwood lumber prices operating within the lumber industry is regional competition between the Pacific Northwest and the South. There are, of course, large portions of the country in which one or the other

of these producing regions occupies the field without competition from the other; there is, of course, competition potential or actual nearly everywhere from other softwood-producing regions; there is some competition from abroad; and there is always the competition with lumber of its various substitutes. Nevertheless, the general level of softwood lumber prices in the United States is determined primarily by the struggle between these two great sources of supply to dispose of their respective outputs.

Such conditions, of course, confer certain advantages on the consumer—though less, after all, than might be supposed. For if wholesale prices may drop sharply at any time because of a temporary oversupply of lumber, the dealer fears to carry normal inventories; and elements of uncertainty are introduced that tend to disrupt distribution as well as to create speculative risks. From these conditions nobody in the long run benefits. It is at least debatable if the ultimate consumer's interest has gained more than it has suffered in consequence of eastern lumber market instability and the resulting disturbance of the distributive service, with price fluctuations that presumably have seldom been passed far enough down the line to lower by very much what the consumer has had to pay.

In preventing the consequences of southern forest depletion from becoming more marked, the advent of west-coast lumber in quantity upon the eastern market has simply repeated the history of each successive regional depletion in the past. When the virgin forests of the Northeast began to fail, the Lake States timber prevented the development of a condition of acute scarcity; and when the Lake States forests dwindled southern pine came into its own. Each of the great forest regions has been like a vast reservoir, ready to be tapped when its turn came. The barrier that has in each case held back the timber from coming on the national market ahead of its turn has been the cost of transportation. The longer the haul to the central markets, the higher the price that those markets must be ready to pay in order to make a new source of supply available. The Panama Canal, however, largely offsets the effect of the long haul from the Pacific coast. Lumber moving via the canal from Puget Sound to New York has been paying in recent months a freight charge ranging from \$12.50 to \$14 per thousand. The freight rate on lumber shipped

from Hattiesburg, Miss., to New York is approximately \$11.60 per thousand.

The pressure to produce and market western lumber causes waste of the virgin timber in spite of the fact that the industry itself is keenly interested in lessening waste wherever this is practicable. The lumberman does not willingly leave in the woods or send to the burner material which if manufactured would give him even a small margin of profit. On the contrary, often he takes material that costs him more than he can get back. The industry is seeking efficiency along the same lines as other industries. It has lowered production costs through improved machinery and other methods of saving labor and increasing its percentage of utilization. As time goes on, more and more of the tree will be converted into industrial products. In short, the cause of the present waste of virgin timber is not to be found in the attitude of the lumbermen, who would gladly utilize more closely if they could, but in certain economic maladjustments that the lumber industry can not alter.

In the light of the event it is plain that a great economic mistake was made when the private acquisition of so much of the standing timber in the far West was facilitated, under a public policy of disposal. The too tardy creation of the national forests has mitigated but could not avert the disastrous consequences of passing into private hands so large a portion of the public timberlands, so long before the needs of the country would call for their productive utilization. The public concern in the matter, of course, relates not to the difficulties in which timber owners find themselves because they acquired more stumpage than they can carry, or misjudged the future market; nor primarily to extending a special form of governmental assistance to a particular industry in order to enable it to solve its own individual problems; but to the effect upon the general welfare of a fundamentally unsound economic situation. It is of much more concern to the public to get rid of conditions that handicap the forest owners in the Northeast, the South, or the Lake States who want to use their land to grow timber crops than it is to enable Pacific coast lumber companies to liquidate with a profit. It is of much more public concern to prevent

forest destruction and forest land nudation and abandonment in the West, with the depressing commur effects that follow the wind-up of lo forest industries, than it is to s bilize the eastern and national l ber markets as such. And this true notwithstanding the fact t orderly marketing of any essen commodity and sound and prosper conditions in all industries are n ters of public as well as private sol tude.

By and large, the lumber indus must work out its own internal problems—and they are both large a difficult. It is already applying its to the task. What will eventu have to be worked out is not mer greater industrial efficiency but making over of the industry from unrelated to and unconcerned w forest production to one correla with and based upon the use of l for sustained, permanent supplies whatever quantities and kinds of material the industry can profitab turn into marketable manufactu products; from a migratory and t sitory into a fixed and permanent dustry. And this is more than an ternal problem of the lumber indus. It is also a public end—the attainm of a sound forest economy.

The greatest weakness of the ind try at the present time is due to fact that it owns an enormous are forest land acquired not as land as forest, is burdened, where it not liquidated most of its stump with very heavy investments in material that must be carried years before it can be put to use, has a set-up based solely on the ma facture of this raw material as rap as may be. As a manufacturing dustry it is embarrassed by the tent to which its capital is tied up timber and its profits are depend upon the way this part of its inv ment works out. As an exten owner of land it is embarrassed the fact that its land ownership auxiliary to a manufacturing inte entirely unrelated to the land a productive resource and uninter in its future, but with purposes of own that, when carried out, sac the land values for the sake of ma facturing profits.

The embarrassing feature in case arises chiefly from the fact the profits accrue to the enterpr

ut the sacrifice is inflicted upon the public, which is made poorer by the lowered productive value of the land. Thus the industry is confronted with an awkward question. Having acquired land in order to have timber for use in its own way and for its own purposes, to what extent may it have acquired along with the land a moral responsibility or public obligation in connection with its use? It is to the credit of the industry that it is putting this question to itself.

The immediate effect is to add to the embarrassments under which the industry labors in consequence of its own internal problems. The ultimate effect should be to hasten the adjustment which must be made anyhow before the internal problems of the industry will be entirely solved. The present adjustment of the industry to the forest is essentially a maladjustment. Without implication of censure, it may fairly be called an anachronism. To the extent that our forest economy is still based upon the lumbering of virgin stands with disregard for the preservation of forest productivity and the future of the land, it is a hold-over from the past rather than a shaping of present methods to square with approaching conditions.

In the eastern half of the country, where originally three-fourths of the virgin timber grew and where to-day three-fourths of all the lumber produced in the United States is consumed, depletion has gone so far that not for the remaining western supplies our forest economy would be based primarily on the cutting of second growth. For the hardwoods, indeed, and for a large part of the wood consumption for local purposes, second growth is already in a dominating position. As that comes about, a profoundly altered situation is created. High-grade material previously held essential for many industrial purposes either ceases to be procurable at all or becomes so scarce and so expensive that radical readjustments of consumption are forced. Ingenuity in devising new ways of meeting industrial needs is stimulated to a degree that substantially lessens the hardships and burdens imposed on industry and the public. At the cost of many dislocations and a considerable net loss, consumption is, in part readjusted so that the second-growth forests con-

tain, in part to the substitution of other material for wood.

Inevitably a stable relationship of the forest industries to the forest land will in time be worked out. The forest owner will know what to grow, to whom he can expect to sell, and what prices for his output he can reasonably look for. But the process of readjustment to a forest economy based on timber growing should, if possible, be facilitated by a constructive public policy with respect to the far-western situation. Its formulation is not a task for foresters alone. It will call for the participation of financiers, economists, and leaders in the field of governmental and business relationships. For it is a question of devising some plan of action that will substitute orderly marketing for the present pressure to liquidate, without creating a monopolistic control of lumber prices by private interests or transcending the limits of sound public policy.

Failing the discovery and successful adoption of such a plan, economic forces acting within the limitations set by existing laws will have to work the matter out blindly and without regard to the public interests that are jeopardized. Forced liquidation, with its inevitable waste of the timber resource and postponement of the transition to a sound national forest economy, will gradually reduce the overload. As the more accessible stumpage melts away increasing costs of production and transportation will tend to raise the minimum price levels at which the western lumber can be placed on the eastern markets. Long before the last great reservoir of virgin timber is drained it will have ceased to interfere with the transition of the East from dependence primarily upon our original forests to dependence primarily upon new growth. It is quite probable that another decade will bring pretty nearly to an end the period of acute pressure to liquidate, which at the present time makes impossible faster progress toward the establishment of an equilibrium between supplies and consumption and the attainment of a sound forest economy. But the loss of even a decade in applying forestry to the land, which should have begun long ago to grow the new crops that will be badly needed long before they are ready to harvest, is a loss that the country can ill afford to suffer.

FORESTS AND LAND USE

Until relatively recently the aspect of our national problem of forestry which has chiefly engaged public attention has been the need to provide against a future shortage of timber; and in popular discussion the depletion and approaching exhaustion of our forest supplies still serve as the commonest argument for seeking to extend the practice of forestry. While it is entirely true and worthy of emphasis that our future requirements for wood make reforestation and the prevention of forest destruction a matter of large public importance, of still more immediate and tangible concern at the present time is the menace of nonproducing land and the destruction of land values for permanent productive use.

Perception of this menace is growing locally, through actual experience of the economic and social burdens imposed as denuded forest land ceases to be worth paying taxes on, or as attempts to cultivate it establish its essentially submarginal character for agriculture, or as the blight of impoverishment spreads sectionally through the loss of forest resources and the migration of forest industries. This is giving a new impulse to the movement for public forestry. It is particularly effective because it is originated not through the anticipation of a future general evil, but through the sharp sense of a present local one. It is beginning to exert a powerful influence for enlarged State policies of forestry, and to a considerable extent for an enlarged program of Federal land acquisition and national forest administration.

The latter is discussed farther on in this report. It may be mentioned here, however, that in addition to the demand for more purchases of land for national forests in the East, there is in two of the far Western States a growing perception of the danger of extensive tax delinquency and land abandonment following lumber operations, and a definite desire for national forest extension to bring cut-over lands under Federal administration as a means of preserving their productivity.

On the whole, the Lake States include the region in which the accumulation of cut-over waste lands has made most impression on the public mind and has called forth the most definite reaction in favor of remedial measures.

The northern two-thirds of the States of Michigan, Wisconsin, and Minnesota formed the original Lake States pine regions. During the past century the region supplied a cut of over 300,000,000 feet of softwoods, chiefly pine. In the nineteenth century, the cut of Lake States pine, in the closing decade of its peak, was approximately 6,000,000,000 feet annually. In 1927 it was less than 450,000,000 feet—a loss of about 85 per cent of the cut in 20 years. Only scattered remnants of the original forest growth remain, and the estimated area of merchantable second-growth is less than 14,000,000 acres of a total land area for the three States of nearly 124,000,000 acres.

The southern third of the Lake States, originally occupied by hardwoods, with some prairie that in the extreme western part of Minnesota extended northward to the Canadian line, has been turned into prosperous agricultural country, but the great bulk of the pine region has proved unsuitable to agriculture. Many settlers have tried in vain to make a living on the lands. On the occasional areas of better soils, however, agriculture may succeed. Since the amount of farmland on which a decent living can be made is too small to supply by itself an adequate basis for the support of local government, the maintenance of roads and schools, and the railroad traffic necessary to adequate rail transportation facilities, the waning of timber and the disappearance of forest industries have brought economic retrogression, railroad abandonment, mounting tax burdens, depopulation, and in some cases county bankruptcy.

About 20,000,000 acres in the Lake States pine region is land which, though better suited to forest production than to any other purpose, has been so nearly reduced to unproductiveness that much, if not most, of it will have to be reclaimed through artificial reforestation; and unless protection is systematically maintained throughout the region the amount of denuded and worthless land will grow. Tax delinquency is very extensive with the prospect of eventual enforcement of public ownership of a substantial percentage of the land, via tax forfeiture.

In Wisconsin alone over 2,500,000 acres of land in the 17 northern counties were represented in the tax certificates offered for sale in the six

year 1927, and more than 4,250,000 acres in these counties had been tax delinquent one or more times previous to that year. In Minnesota the State Reforestation Commission report of last November stated that the amount of tax delinquency in the forest area is steadily rising and in one or two counties includes over half the taxable land area, and that the situation has resulted in confiscatory tax rates. In Michigan the State Conservation Commission reported under its jurisdiction at the close of 1928 approximately 1,500,000 acres of "tax homestead" lands, and in the same report the State forester declared 15,000,000 acres to be a conservative estimate of the total amount of "just such land as has reverted to the State."

All three States are awakening to the urgency of the land use problem created by forest destruction, are seeking suitable remedial measures, and are coming to recognize that a very large task of public-land ownership and administration with a view to restoring productivity through reforestation will have to be assumed, in addition to the finding of means for bringing about forest management by private owners. In New York likewise there is a new movement for the enlargement of public ownership and reforestation to meet the idle-lands evil, primarily arising in that State from the abandonment of farming on submarginal agricultural lands. Every considerable section of the East in which farms have been created by clearing presents the same sort of problems that the Lake States and New York are having to face. Further, in a majority of the Eastern States there is interwoven the problem of erosion and of flood control. In short, the question of right land use, vital alike to rural welfare and to sound national development, ramifies into many fields and wears many aspects, yet calls for a comprehensive, not a piecemeal, answer.

Agriculture and forestry together must supply the answer, and must work together to find it. Submarginal agricultural lands must be distinguished from those worth cultivating, and an effort made to find ways of guiding and assisting both agricultural development and ownership for forest use along lines that will best serve the public welfare. The right outcome will be attained when there

has been brought about such an adjustment of agriculture to forestry, of forestry to agriculture, and of both to the soil resource as will enable the land to contribute to the most favorable economic and social conditions of rural life.

The reverse is happening now, on a tremendous and appalling scale. The extent of the losses which the Nation is suffering through the erosion of lands that are under cultivation is just beginning to be perceived. Erosion and its consequences in the form of altered stream-flow conditions and silt discharges impose larger public obligations than have as yet been recognized for the regulation of forest use in a large part of the East, and of range use in the West. To make regulation effective where the protective function of the forest is important, public ownership will have to be greatly extended. The program that will ultimately have to be formulated for this purpose, and that doubtless will ultimately be accomplished by a combination of Federal and State effort, can not be known without extensive and detailed study of the whole problem of erosion and flood control. In every direction, indeed, research is fundamental to the working out of a sound system of forest land use. But nowhere is there more urgent need to bring into play new forces for reversing present trends in the forest situation than can be found in much of the southern pine country.

For various reasons, tax delinquency has not as yet become conspicuous in the South as the aftermath of forest destruction. For one reason, the main development of lumbering in the "piney woods" followed that in the Lake States, so that there has not been time enough for the full force of the economic consequences to be felt. A great deal of the southern pine land still has considerable merchantable timber on it, partly as a result of regrowth, partly because more or less timber was left at the time of the original cutting. Some lumbermen who bought land in order to cut the timber off it believe that they can dispose of the land sooner or later for agricultural purposes; some, that it has value for grazing, or may be underlain by valuable minerals of one kind or another; some, of course, see that they can cut more timber from the land; while some hold

simply on the general principle that land is always worth something and will eventually have a market.

A few owners have in recent years become converts to the idea that timber growing should pay, and are planning to use the land for this purpose. A much larger number are farmers or estate owners, with every expectation of continued proprietorship. Thus a good share of the land is in stable ownership. In general, the percentage held by owners whose attitude toward the land is essentially speculative, as contrasted with those whose purpose is to keep and make use of the land, is lowest in the more easterly part of the southern pine belt and rises in the Gulf States with progress westward. A high degree of instability of ownership is found west of the Alabama River.

With the virgin stands of timber nearly gone, the tendency is to return to the lands already lumbered for whatever was left at the time of the first cutting or has come up as second growth. Saw logs from single trees scattered here and there over a large area can be profitably picked up and transported by motor truck 20 or 30 miles to a mill; portable sawmills seek out patches of young timber; and the market for poles and fence posts affords another opportunity to obtain from the land a little current return with which at least to pay taxes. Thus it is possible to carry the land until the last vestiges of the forest vanish through the removal of all the trees that might, if left, mature and scatter seed, and through unchecked ground fires that wipe out all the established reproduction. The financial requirements of the States and local communities make probable higher rather than lower land taxes. Many millions of acres in the South have reached a degree of denudation that virtually precludes any hope of their restoration to productiveness as a private undertaking and apparently insures their eventual abandonment to the public through tax forfeiture. In much of the southern pine region the history of the Lake States pine region will be repeated.

It is true that this is only part of the picture. Much of the South holds out a bright prospect for extensive private timber growing; the States are making rapid progress in fire protection and in building up capable forestry departments; and the interest of

landowners in the possibilities of a forestation is becoming fairly widespread. Nevertheless, the fact needs to be faced squarely that not near enough is being done, and that at the very best a gigantic task of forest reclamation is going to be forced upon the public as the only alternative to permanent land unproductiveness on a major scale. Whether even the public can afford to reforest all the southern forest land that has been will be denuded and that private owners will not wish to carry is a question.

Whatever is done will, to a large extent, have to be done locally, through State and county action. While the Federal Government has inaugurated land purchases for the establishment of a number of small forests scattered through the southern pine region, these are primarily for demonstrative purposes. How much more than this if any more, the Federal authorities should undertake can be determined only after the whole situation has been studied further, trends have been observed, the workings of other remedies have been taken account of, and, above all, local realization of the needs has been fully developed and local efforts to meet them have been made.

The most urgent immediate need are better knowledge as to the facts and greater effort to bring about the use of land for timber growing as private enterprise. The States should recognize the problem that lies ahead of them, as the Lake States have done and should seek through such means as commissions of inquiry, land economic surveys, and the like, to analyze it and formulate a forward-looking course of action. State forest departments should be given greater scope and greater support; protection of forest lands against fire, the greatest of all causes of denudation, should be extended; and State policies of taxation should be overhauled and adjusted so far as possible to the necessity for preventing large amounts of land from becoming a public liability through loss of its productiveness. The whole situation will have to be worked out gradually, through experience and through research.

The latter is fundamental to any satisfactory progress. It is needed as a means of determining the basic economic facts that must be understood before sound public policies can be elaborated or private policies of land

use safely embarked upon, and it is needed in order to develop the best technical practices of timber growing and forest utilization. In the field of research lies one of the greatest opportunities for helpful Federal action. Both the importance of the forest resource and the public dangers that its destruction involves make increased effort in this field not merely desirable but almost imperative.

PROGRESS IN STATE FORESTRY LEGISLATION DURING THE YEAR

The form of the State organization for forestry work was modified in Nebraska by consolidating this work with the administration of State parks, game, and fish under a single board, and in West Virginia by setting up a chief forester in the department of game, fish, and forestry (renamed from the old game and fish commission).

Considerable legislation was enacted looking to enlarged policies of State forests. New York amended the conservation law to permit the purchase and development of State forests outside the "preserve counties" of the Adirondack and Catskill regions. California provided for setting aside and placing under management as State forests tax-delinquent cut-over lands. Indiana, New Jersey, Ohio, South Carolina, and Vermont authorized land purchases or the acceptance of gifts of land, or both, for State forests and forest parks. In Ohio the authorization covered acceptance of a gift not only of land but also of a fund of more than \$1,000,000 for maintenance and further purchases.

South Carolina, besides authorizing both purchases of land and the acceptance of gifts, directed that certain waste lands be made over to the State commission of forestry for use in establishing forest-tree nurseries or for other forest purposes. Montana authorized the acceptance and setting aside of donated lands as State parks for camping and recreational use, and Minnesota provided for acquiring small tracts of land, by gift or in certain cases by purchase, for the use of the State in forestry and fire-prevention work.

Rhode Island provided for the establishment of town forests, while New York took a notable step to bring about the establishment of county forests throughout the State. Up to a maximum of \$5,000 yearly, State funds are

offered any county that will contribute at least equally to buy lands whose purchase for county forests is approved by the State Conservation Commission. This, together with the provision already mentioned for establishing State forests outside the Adirondack and Catskill regions, are evidences that the State is becoming aroused to the need for more public ownership as a means of lessening the accumulation of idle lands, due largely to their abandonment for farming.

County forests may become a more important factor in reforestation than has usually been imagined. The Wisconsin forest tax law, the enactment of which was mentioned in last year's report, is proving a strong incentive to the counties in that State in which tax-delinquent cut-over lands are accumulating to put these lands into county forests, in order to obtain the offered State financial assistance. In the State of Washington likewise, where as in Wisconsin tax-reverting lands pass not to the State but to the counties, the accumulation of such land is causing forest administration by the county to be seriously considered. The New York policy will be watched with interest by observers in many States.

Federal land acquisition for national-forest purposes was given a broader field in Mississippi and North Carolina, which removed limitations imposed by their original enabling acts. Missouri passed an enabling act, but limited the area that may be purchased to 2,000 acres in any one county. Mississippi, which has had a 25,000-acre limitation, now leaves the amount of land that may be acquired to the Federal Government and the State forestry commission, and North Carolina no longer limits purchases to the western part of the State.

Forest tax legislation was enacted by Connecticut, allowing exemption for growing timber until it reaches merchantable size; by North Carolina, in the form of initiation by the legislature of a constitutional amendment that will permit forest property to be taxed under uniform special provisions; and by Washington, through adoption of a constitutional amendment that accomplishes the same result.

Maine simplified her existing tax law in administrative details and as to the conditions enabling property to qualify under it, and also readjusted the rate of taxation. Idaho provided that forest-producing lands listed

with the State cooperative board of forestry may be taxed on a valuation of \$1 per acre, with a yield tax when timber is cut of 12½ per cent of its stumpage value. The 50-year listing period may be extended by renewing the contract to produce timber on the listed area. Minnesota changed the tax law by substituting a fixed annual specific tax for a fixed annual ad valorem tax. Oregon passed a reforestation law which prescribes an annual tax of 5 cents per acre while the timber is maturing and a yield tax of 12½ per cent of the value of the crop when harvested. In addition the owner is required to provide protection of the growing crop from fire. All lands subject to classification come under the provisions of the law.

Many States strengthened their forest-fire legislation. Idaho authorized the State forester to enjoin the further cutting of timber on operations where the law requiring slash disposal has not been complied with, and prescribed a maximum fine of \$1,000 for burning slash in the closed season without a written permit or for violating the terms of the permit. California authorized the State board of forestry to designate, upon written petition of the owners of 50 per cent or more of the forest land, any region or zone as a hazardous fire area, within which fires may not be built except at established camp sites. California also authorized municipalities to contract with the county to furnish fire protection. Washington made failure to equip all spark-emitting engines with modern spark arresters, main-

tained in good condition, a misdemeanor. Minnesota broadened the slash disposal law to include any accumulation of timber debris or inflammable refuse from the manufacture of lumber or other timber products. Pennsylvania authorized suit on behalf of the Commonwealth to recover the expenses incurred in connection with forest fires, and empowered the chief forest fire ward to declare a public nuisance any property which, by reason of its condition or operation, is a special forest-fire hazard and, as such, endangers other property or human life. The owner must abate such public nuisance, pay a fine plus the cost of its abatement.

Idaho made it a misdemeanor to throw any lighted cigarette, cigar, match, ashes, or flaming substance from any vehicle or upon any place where it may directly or indirectly cause a fire resulting in damage to forage on lands of the United States or the State of Idaho, or to the property of any person. The California Legislature passed a bill which was not signed by the governor, requiring motor vehicles to carry receptacles for burnt matches, pipe ashes or coals, and cigarette and cigar butts.

WORK OF THE YEAR IN STATE COOPERATION

The appropriations for cooperative work with States during the fiscal year 1929 are compared with those of the previous year and for the fiscal year 1930 in Table 1.

TABLE 1.—*Appropriations for State cooperation 1928-1930*

Item	Amount appropriated for fiscal year—		
	1928	1929	1930
For the prevention and suppression of forest fires and for the forest taxation inquiry (sections 1 to 3 of the Clarke-McNary law).....	\$1,000,000	\$1,200,000	\$1,400,000
For the distribution of forest planting stock to farmers (section 4 of the same law).....	75,000	75,000	80,000
For farm forestry extension (section 5 of the law).....	60,000	60,000	60,000

The amounts given above do not include the sums added in consequence of the Welch law, providing for salary increases. The appropriation under the third item is expended by the Extension Service of the Department of Agriculture. The results of the work are summarized below, except for the taxation study, which is covered on

page 48. Table 2 shows in detail Federal, State, and private funds disbursed by the States or expended under their supervision for the prevention and suppression of forest fires and the Federal and State funds disbursed by the States for the protection and distribution of planting stock.

TABLE 2.—Cooperative expenditures in fire protection and the distribution of forest planting stock under the Clarke-McNary Act, fiscal year 1929

State	Fire protection				Distribution of forest planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Alaine	\$50,550.00	\$120,010.83		\$170,560.83	\$1,371.52	\$1,371.52	\$2,743.04
New Hampshire	15,045.99	29,049.04	6,562.42	50,657.45	2,100.00	4,946.07	7,046.07
Vermont	7,448.00	5,216.36	3,817.14	16,481.50	2,000.00	8,324.36	10,324.36
Massachusetts	23,010.00	90,489.92		113,499.92	2,100.00	7,472.74	9,572.74
Rhode Island	1,374.00	10,419.42		11,793.42			
Connecticut	7,620.00	45,313.66	2,410.39	55,344.05	2,000.00	2,895.43	4,895.43
New York	56,242.00	224,629.89		280,871.89	4,200.00	112,652.57	116,852.57
New Jersey	17,464.00	60,553.09		78,017.09	2,350.00	6,628.85	8,978.85
Delaware	765.00	850.21		1,615.21	2,000.00	3,432.73	5,432.73
Pennsylvania	44,298.00	161,529.93		205,827.93	2,400.00	21,909.51	24,309.51
Maryland	7,410.00	28,347.25	1,911.20	37,668.45	2,000.00	5,624.09	7,624.09
Virginia	30,991.00	30,360.87	7,189.38	68,541.25	2,000.00	3,000.91	5,000.91
West Virginia	21,162.00	51,800.38	9,065.38	82,027.76	1,000.00	1,480.37	2,480.37
North Carolina	41,438.00	51,508.73	10,056.77	103,003.50	2,000.00	2,299.05	4,299.05
South Carolina	11,808.70	3,784.21	8,093.05	23,685.96	1,692.16	1,692.16	3,384.32
Georgia	38,380.00	21,746.56	40,081.86	100,208.42	1,970.96	1,970.96	3,941.92
Florida	35,000.00	10,583.79	26,535.13	72,118.92	555.00	802.85	1,357.85
Ohio	4,103.00	21,584.02		25,687.02	2,100.00	8,259.70	10,359.70
Illinois	850.00	5,367.78	1,350.00	7,567.78			
Indiana	1,700.00	1,779.15		3,479.15	2,000.00	12,422.09	14,422.09
Iowa					2,000.00	2,045.01	4,045.01
Missouri	7,909.90	7,909.91		15,819.81	877.08	877.08	1,754.16
Kentucky	9,311.31	9,311.34		18,622.65	2,000.00	2,397.67	4,397.67
Tennessee	21,260.00	19,577.07	8,434.96	49,272.03	1,000.00	3,410.82	4,410.82
Alabama	37,137.23	26,560.27	11,138.93	74,836.43	2,230.00	2,370.64	4,600.64
Louisiana	41,037.00	28,990.97	50,704.20	120,732.17	2,000.00	2,847.25	4,847.25
Mississippi	33,515.00	37,069.84		70,584.84			
Texas	30,722.00	31,847.39	6,512.63	69,082.02			
Oklahoma	15,830.00	8,105.21	8,987.33	32,922.59	2,220.00	4,172.84	6,392.84
Porto Rico					2,200.00	14,382.47	16,582.47
Montana	20,228.00	15,168.61	50,026.12	85,422.73	1,132.00	1,132.00	2,264.00
Idaho	52,371.00	53,981.88	135,023.96	241,376.84	2,000.00	4,333.49	6,333.49
Kansas					2,000.00	2,321.33	4,321.33
Nebraska					2,100.00	8,132.00	10,232.00
Colorado					2,000.00	2,050.40	4,050.40
South Dakota	375.00	4,067.00		4,442.00			
Wyoming					972.17	972.17	1,944.34
North Dakota					2,000.00	3,591.54	5,591.54
New Mexico	1,916.00	5,683.00		7,599.00			
California	55,595.00	110,116.92	74,803.79	240,515.71	687.00	700.94	1,387.94
Hawaii					2,400.00	19,190.12	21,590.12
Washington	72,355.00	66,997.54	226,808.98	366,161.52	2,000.00	2,143.02	4,143.02
Oregon	67,912.00	65,038.72	213,548.49	346,499.21	2,000.00	2,013.14	4,013.14
Wisconsin	33,136.00	120,577.93		153,713.93	1,533.00	3,406.30	4,939.30
Michigan	77,694.00	307,506.33		385,200.33	2,000.00	5,568.77	7,568.77
Minnesota	73,883.00	226,223.80	19,611.75	319,718.55			
Administration and inspection	77,680.88			77,680.88	1,181.18		1,181.18
Total	1,146,523.01	2,119,658.82	922,673.91	4,188,860.74	74,372.07	295,244.96	369,617.03
Forest tax studies	61,493.50						
Unexpended balance	1,780.49				1,107.93		
Total appropriation	1,209,802.00				75,480.00		

In addition to the expenditures for fire protection shown in Table 2, approximately \$116,000 was reported as expended independently by private individuals and associations. A much larger sum was undoubtedly so expended. In some States very substantial contributions were thus made to the protective work.

COOPERATIVE PROTECTION OF STATE AND PRIVATE FOREST LANDS FROM FIRE

State activity in forest-fire protection is advancing slowly but steadily

from the stage in which the State assumes no responsibility and takes no part to the stage now reached in a few States, where State and private owners and the Federal Government are carrying through a cooperative program of effective state-wide protection. In 1928 the States reported some form of systematic protection on 235,000,000 acres, 57 per cent of the 414,000,000 acres of State and private lands in need of such protection. The progress made in the last four years is shown in Table 3.

TABLE 3.—*State and private lands under organized protection*

Calendar year	Area	Gain over previous year
	<i>Acres</i>	<i>Acres</i>
1925.....	178, 200, 000	
1926.....	195, 200, 000	17, 000, 000
1927.....	202, 100, 000	6, 900, 000
1928.....	235, 000, 000	32, 900, 000

Of the 179,000,000 acres needing but not yet receiving protection 88 per cent lies in the South. Here the work is in the early stage of earnest but poorly financed State leadership. Yet there are indications that state-wide protection is on the way. West Virginia now requires private owners to protect their forest land or pay the State for the work. Similar legislation has been proposed in Kentucky. Virginia requires the counties to pay for the suppression of fires under the direction of the State forest wardens, but has not yet provided enough money to make the administration of the law state-wide.

In Mississippi a bill was introduced last winter providing for the establishment of protective districts upon petition of a majority of the forest-land owners. Within such districts all the forest-land owners would be required to support organized protection maintained through an owners' association. The bill affords an excellent example of the tendency to seek local compulsory forest-fire protection where a majority of the owners want it. In various Southern States, including Louisiana, Texas, Oklahoma, Florida, Tennessee, North Carolina, Kentucky, and Virginia, protection by such local associations is becoming well established. Owners who are paying assessments to protect, along with their own land, that of nonpaying owners of intermingling land soon begin to favor a requirement by the State that all owners protect their land or pay for its protection.

The Cape Cod forest-fire prevention experiment, begun in January, 1926,

by the Massachusetts Forestry Association in cooperation with the Massachusetts Division of Forestry and the Forest Service, was completed with the fall fire season of 1928. Its aim was to determine the effectiveness of intensive educational prevention work in fire control. During the three years prior to the experiment \$29,487 was spent for forest fire suppression. During the three years of the experiment the total expenditure for educational work and suppression together was \$23,550. During the three years before the experiment 28,089 acres was burned over; during the three years of the experiment, 5,885 acres. Thus with an outlay 20 per cent less a 79 per cent reduction in the area burned took place.

Revised estimates of the cost of protecting State and private lands from forest fires in the several States were initiated during the year, to be completed January 1, 1930. The estimate of cost of protection in each State partly determines the amount of the Federal allotment of funds. After their submission by the States the estimates will be analyzed and correlated by the Forest Service with the assistance of a special committee of the national association of State foresters.

The record of forest fires for the calendar year 1928 is given in Table 4. As compared with 1927, a large increase in the area burned is shown. The 1927 record for protected lands was 2,784,450 acres, as against 4,428,500 acres in 1928, and for unprotected lands was 35,747,380 acres as against 39,502,810 in 1928. For the unprotected areas, the available data are too fragmentary and inexact to permit of more than rough estimates, though the records are becoming steadily more complete. Regarding the protected area, it should be borne in mind that it was over 35,000,000 acres greater in 1928 than in 1927. An abnormal severe spring fire season in the Middle Atlantic, Gulf, and Central States and a bad late fall season in the Northwest increased the area burned over.

TABLE 4.—Summary of forest-fire statistics, by groups of States, for the United States, exclusive of Alaska, calendar year 1928

Group of States ¹	Number of fires				Damage			
	On protected area	On unprotected area	Total	Per cent	On protected area	On unprotected area	Total	Per cent
United States.....	40,579	136,783	177,362	100.0	\$8,583,620	\$74,350,600	\$82,934,220	100.0
Northeastern.....	3,098	-----	3,098	1.8	407,470	-----	407,470	.5
Middle Atlantic.....	4,437	-----	4,437	2.5	1,075,500	-----	1,075,500	1.3
Southeastern.....	3,438	35,991	39,429	22.2	653,540	22,606,200	23,259,740	28.1
Gulf.....	12,987	99,120	112,107	63.2	2,036,070	50,359,270	52,395,340	63.2
Central.....	1,967	1,801	3,268	1.8	420,590	740,500	1,161,090	1.4
Lake.....	3,065	-----	3,065	1.7	164,570	-----	164,570	.2
Rocky Mountain.....	3,643	177	3,820	2.2	475,700	59,800	535,500	.6
Pacific.....	7,944	194	8,138	4.6	3,350,180	584,830	3,935,010	4.7

AREA, IN ACRES, BURNED

Group of States ¹	On protected area							
	Forest land					Nonforest land		
	Mature or merchantable	Protection, forest	Young growth		Total	Protection, brush and grass	No protection or forest value	Total
			Will restock	Will not restock				
United States.....	746,250	78,370	1,854,400	174,150	2,853,170	1,478,820	96,510	1,575,330
Northeastern.....	12,780	-----	33,250	570	46,600	27,440	8,970	36,410
Middle Atlantic.....	37,040	-----	46,340	14,200	97,580	73,000	7,740	80,740
Southeastern.....	99,880	4,340	150,110	21,070	275,380	4,650	1,810	6,460
Gulf.....	366,720	950	1,127,940	69,610	1,565,220	88,260	10,830	99,090
Central.....	83,150	2,980	96,620	1,030	183,780	200	4,550	4,750
Lake.....	1,820	-----	113,570	750	116,140	76,070	44,750	120,820
Rocky Mountain.....	14,890	13,120	44,200	19,030	91,240	31,270	2,110	33,380
Pacific.....	129,990	56,980	242,370	47,890	477,230	1,177,930	15,750	1,193,680

Group of States	On protected area		On unprotected area	Grand total	Per cent
	Total protected area burned	Per cent			
United States.....	4,428,500	100.0	39,502,810	43,931,310	100.0
Northeastern.....	83,010	1.9	-----	83,010	.2
Middle Atlantic.....	178,320	4.0	-----	178,320	.4
Southeastern.....	281,840	6.4	21,011,810	21,293,650	48.5
Gulf.....	1,664,310	37.6	18,059,790	19,724,100	44.9
Central.....	188,530	4.3	195,650	384,180	.9
Lake.....	236,960	5.3	-----	236,960	.5
Rocky Mountain.....	124,620	2.8	44,960	169,580	.4
Pacific.....	1,670,910	37.7	190,600	1,861,510	4.2

¹ Northeastern group—New England States and New York. Middle Atlantic group—New Jersey, Pennsylvania, Delaware, and Maryland. Southeastern group—Virginia, West Virginia, North Carolina, South Carolina, Georgia, and Florida. Gulf group—Alabama, Mississippi, Louisiana, Texas, Oklahoma, and Arkansas. Central group—Kentucky, Tennessee, Ohio, Indiana, Illinois, and Missouri. Lake group—Michigan, Wisconsin, and Minnesota. Rocky Mountain group—Montana, Idaho, Wyoming, Utah, Colorado, Arizona, New Mexico, Nevada, and Utah. Pacific group—Washington, Oregon, and California.

COOPERATION WITH STATES IN TREE PLANTING

A growing interest among farm-land owners in reforesting their idle acres and in maintaining the productivity of their existing woodlands is evidenced by the annual increase in the number of young trees distributed by the cooperating States. Last year nearly 29,000,000 State-grown trees, and an additional number purchased from commercial nurseries, were used by farmers in planting more than 31,000 acres. A million more trees were planted on farm lands in 1928 than in 1927. Many of the State co-operative nurseries which have been established since the passage of the Clarke-McNary law are not yet on a quantity-production basis, and a large increase in the number of available trees may be expected in the next few years. Seventy-five per cent of the planting stock distributed to farmers last year was propagated in the four States of New York, Pennsylvania, Massachusetts, and Ohio.

Cooperation under this section of the law has been requested by agencies in two additional States, South Dakota and Utah, and will be granted as soon as legislation is enacted by those States authorizing the agencies to engage in the production and distribution of planting stock.

Maintaining its policy of assisting the cooperating States in securing certain kinds of tree seed at reasonable cost, the Forest Service cooperative seed collection project on the Chipewewa National Forest in Minnesota was continued. Over 1,000 pounds of Norway pine seed was furnished to the States participating in the project.

A conference of Forest Service and State officials in charge of tree-planting work was held in North Dakota during the year. Commercial nursery-men of the region were officially represented at the conference. A better understanding of the purposes and problems of the tree-distribution work as handled by the States was secured, definite planting objectives for the Great Plains States were adopted, and plans were formulated for the selection of tree species best suited to the area and for greater uniformity in distribution methods, prices of stock, and inspection of proposed and established plantations.

The allotments made to the States cooperating, and their expenditures, were shown in Table 2.

COOPERATION WITH STATES IN FARM FOREST EXTENSION

Management of farm woodlands is that they may bring the fullest returns to the farmer is an important part of a broad program of forestry for the State. It is furthered through projects and programs of the various colleges of agriculture and through the State forestry departments. Federal cooperation in this work, authorized under section 5 of the Clarke-McNary law, is conducted as a part of the extension program of the several State agricultural colleges and administered by the Extension Service of the Department of Agriculture with the cooperation of the Forest Service. The Federal appropriation of \$60,000 for the last fiscal year was used mostly for the employment of extension foresters.

Thirty-one States carried on cooperative extension work in farm forestry. Colorado discontinued its project, and Wyoming enrolled on the list for the first time. A good increase in activities and accomplishments is shown by the record for the year ended November, 1928, the latest available information. As a result of this cooperative effort, improved practices in some phase of forestry were adopted on 18,902 farms. Of these 3,751 farms adopted better practices for the first time. The management of existing woodlands constituted a project on 5,476 farms, an increase of 967 over last year, with a corresponding increase of 85,085 acres involved, making the total 307,224 acres. The 6,082 forest plantations established this year through the efforts of the extension foresters added 16,471 acres. In addition, 3,715 farmers planted windbreaks.

The boys' and girls' 4-H clubs in forestry increased their membership by 864, making a total enrollment of 4,031, and 2,719 completed their projects. This activity among the junior on the farms is to be found in all States, but is of largest importance in New York, New Jersey, New Hampshire, and Wisconsin.

NATIONAL-FOREST ADMINISTRATION

The expenditures for national-forest administration, protection, improvement, reforestation, and extension are shown in detail on page 59, totaling \$21,108,507.16. This is exclusive of expenditures for administration of the

Forest Service as a whole (i. e., general overhead). Increases over last year's national-forest expenditures included \$1,217,962.30 more for improvements, of which \$1,114,054.62 was in the roads and trails items, \$621,051.05 more for protection, \$122,499.56 for administration, and \$78,637.66 for reforestation. An apparent decrease of \$959,283.44 for national-forest extension was due to the fact that the pur-

chase of the Waterville tract in the White Mountains National Forest late in the fiscal year 1928 was accomplished from a 1929 appropriation which Congress made available for earlier use, as was explained in last year's report.

The appropriations of Federal funds for the national-forest enterprise in the fiscal years 1928, 1929, and 1930 are shown in Table 5.

TABLE 5.—*Appropriations of Federal funds for the national forest enterprise, 1928-1930*

Item	1928	1929	1930
General expenses of administration, protection, and improvement.....	\$6, 488, 865. 00	\$7, 119, 673. 00	\$7, 195, 230. 00,
Specifically for—			
Fire and insect control.....	1, 182, 093. 43	1, 269, 996. 57	150, 000. 00
Improvements, tree planting, land and resource surveys, and land adjustments.....	880, 450. 00	1, 005, 270. 00	1, 066, 050. 00
Land acquisition.....	1, 994, 843. 40	1, 005, 156. 60	2, 000, 000. 00
Roads and trails (construction and maintenance) needed primarily for forest protection and development.....	4, 654, 086. 78	3, 540, 511. 91	3, 625, 855. 89
Highway construction and maintenance primarily to meet public needs, as a recognition of Federal responsibility created by ownership of untaxed lands.....	4, 240, 000. 00	4, 500, 000. 00	4, 500, 000. 00

The figures given in Table 5 in the first three items of the 1929 column do not agree with those reported a year ago. The differences in the first and third items were due to the operation of the Welch law, providing for salary increases which added \$305,073 and \$8,820, respectively, to these two items. The large difference in the second item, amounting to \$1,198,104.03, was brought about by a deficiency appropriation of \$1,200,000 on account of fire expenditures and by certain accounting adjustments that diminished by \$1,895.97 the balance available in 1929 from the \$100,000 fire fund expendable either in 1928 or 1929.

Last year's report explained in detail the remaining differences between the 1929 and the 1928 appropriations, due principally to increased provision for fire control, reforestation, and timber sale and range management work. The differences between the 1929 and 1930 appropriations in the first three items resulted from the following changes:

The first item was increased by 59,714 to provide for the employment of additional protective guards and for the purchase of equipment for fire fighting. Further additions of \$16,000 and \$2,100 to this item provided, respectively, for the purchase of a new

boat for use in Alaska and for Welch law salary increases, while the provision for Washington office expenditures in connection with national-forest administration was reduced by \$2,157 and the provision for the Ogden supply depot by \$100.

The second item is deceptive in two particulars—first, the figures given for 1929 and 1930 comprise solely the specific appropriations for fire control, the provision for insect control having been carried in 1929 from the second into the first item through a shift of \$75,000; second, the entry for 1930 shows only the amount carried by the agricultural appropriation act, whereas the 1929 entry includes the amount made available during the year by a deficiency appropriation. Instead of appropriating a large sum in advance for fire fighting, Congress looks to the Forest Service to meet whatever situation develops, relying upon a deficiency appropriation to replenish its funds to the extent necessary. The \$150,000 shown as appropriated for 1930 is in point of fact the same amount as was initially appropriated for the same purpose by the 1929 agricultural appropriation act. In both years it included a \$100,000 fire fund and \$50,000 for aerial patrol. Owing to the severe fires of

the summer and early fall of the present calendar year, a deficiency appropriation of at least \$3,000,000 for the fiscal year 1930 will probably have to be sought.

Under the third item in Table 5, the 1930 appropriations increased by \$10,000 the provision for camp-ground improvements, by \$55,000 that for range improvements, and by \$10,088 the funds available for the construction of protective improvements (principally lookout towers and houses). Reductions were effected by the disappearance of the special 1929 provision of \$9,000 for building a dam at Cass Lake, Minn., and by decreases of \$2,220 in the tree-planting funds, \$3,042 in those for estimating and appraising the national-forest resources, and \$46 in the provision for land classification and examination.

The apparent difference between the 1929 and 1930 appropriation under the fourth item in Table 5 was in consequence of the purchase of the Waterville tract, already explained. The last two items in the table show an identical provision with that of the previous year for the so-called "forest highways," but a small increase in the funds available for the "forest-development" roads. The increase is due wholly to the fact that 10 per cent of the receipts from the national forests go into the forest-development road fund; both for 1929 and for 1930 the amount in excess of \$3,000,000 shown under this item is derived from the receipts of the previous fiscal year.

It should be said with regard to the road funds that unexpended balances carried forward from one fiscal year to the next cause considerable variations between the amounts shown in Table 5 as appropriated for each year and the amounts actually available for expenditure. The table disregards carry-overs of road funds, since not to do so would tend to obscure rather than to clarify the roads situation.

PERSONNEL TRAINING

In previous reports some mention has been made of the attention that the Forest Service has given to training its personnel in the efficient handling of the highly diversified tasks that have to be performed. One of the means to this end has been discussion courses carried on by mail, for groups of field men scattered on the national forests of a district. In the winter of 1927-28 a service-wide training project had to do with accounting, and particularly with cost accounting.

The determination of unit and activity costs in the work of the Forest Service is a particularly vexing question because of the diversity of activities, the difficulty of making accurate and uniform charges for time of employees, and the problems raised in making satisfactory distribution of indirect and overhead charges. More than 100 men pursued the study. It was designed primarily to stimulate the thoughtful application of recognized principles and practices of accounting to the financial and management problems confronting each individual. The "conference by correspondence" device secured an interchange of knowledge and experience. On the basis of the conclusion reached, a group of skilled accountants prepared plans for an extensive revision of the method of cost accounting used by the Forest Service. This new, and, it is believed, sounder system of cost accounting was put into experimental use on a few national forests July 1, 1929. After a year of trial and development it will be installed on all national forests.

During the winter of 1928-29 over 400 men, including some of the highest rank, participated in a similar study of executive management. Accepted principles of industrial executive management were assembled and circulated in a form designed to stimulate discussion and relation to the executive-management problems of each individual. This study, like the one of cost accounting, will be followed up with such steps as seem most appropriate for strengthening the executive management of the national forests.

JOB ANALYSIS AND PLANNING

In the report for the fiscal year 1927 some account was given of the methods employed in controlling the expenditure of the 80 per cent of the regular appropriation for the Forest Service which goes into salaries, wage travel, and other items that form part of the cost of personal service. In the spring of 1927 an important new development was started in this field. The work of local forest officers is so scattered in time and place that a foreseeable work needs to be organized in advance and routed in trip plans to afford the best sequence of jobs. For still better control of the use of time systematic analysis of jobs was undertaken. The method followed was to set up the objectives of each range or district, determine all of the jobs necessary to attain them, and establish for

each job standards of perfection, intensity, methods, and practice. Time studies disclosed the amount of time needed to meet each job standard. The quantity per year of recurrent work was also ascertained and the best time to handle each phase of it was decided. Such an analysis raises for decision any questions of policy and practice. Correlation and coordination in purposes, methods, standards, and requirements are admirably served, unwise or relatively unimportant uses of time are revealed, and a conclusion is established as to the number of days of work required to carry the job load and the approximate weight of the load for each ranger district. The same method is now being applied to the work of the forest supervisors, and in a somewhat modified form has been employed for the Washington office of the Forest Service. It has produced important betterments in organization and economies in financial management, revealing opportunities to get work done that could otherwise appear beyond the power of the available personnel. The higher up it is carried, the more important does the question of function become, until it reaches the very heart

of organization adjustments and structure. It should make a large contribution toward working out for the entire Forest Service the most efficient mechanism of organization, from top to bottom.

THE NATIONAL-FOREST PROPERTIES

The gross area of the national forests on June 30, 1929, was 184,564,953 acres. This included 24,814,433 acres not owned by the United States. The net area was therefore 159,750,520 acres. The gross area increased 200,134 acres; the net area 269,664 acres.

By Executive orders, the Camp Humphreys and Tobyhanna Military Reservations, in Virginia and Pennsylvania, respectively, were removed from national-forest status, reducing the gross area by 26,443 acres, while exchanges with private owners of lands outside the former forest boundaries added 33,968 acres, purchases of nursery sites added 90 acres, and area recomputations based on better surveys and land data added 11,649 acres. The other gross area changes of the fiscal year are listed in Table 6.

TABLE 6.—*Additions to and eliminations from the gross areas of the national forests made by acts of Congress, presidential proclamations, Executive orders, and State land exchanges*

National forest	State	Additions	Eliminations	National forest	State	Additions	Eliminations
		Acres	Acres			Acres	Acres
Absaroka	Montana		¹ 3, 072	Missoula	Montana	¹ 4, 480	
Blackfoot	do.		² 1, 099	Monongahela	Virginia and West Virginia	¹ 103, 550	⁴ 98, 100
Gallatin	Washington		³ 43, 297	Olympic	Washington		² 34, 591
Grosvonts	Alaska		² 8	Powell	Utah		¹ 12, 455
Grand Canyon	Arizona		³ 36	Shoshone	Wyoming	¹ 50, 560	¹ 85, 472
Grand Prairies	California and Nevada	¹ 8, 299		Sioux	Oregon		² 9, 644
Headwaters	Montana		² 292	Snoqualmie	Washington		² 2, 756
Latford	do.		¹ 27, 008	Teton	Wyoming		¹ 95, 185
Nez Perce	South Dakota	¹ 2, 440		Toiyabe	Nevada		³ 800
Pack	Michigan	⁴ 423, 889		Tongass	Alaska		² 234
Pawnee	California		¹ 24, 919	Tonto	Arizona		³ 85
Piedmont	Michigan		⁴ 13, 635				

¹ Made by acts of Congress.

² Made by State land exchange.

³ Made by Executive order.

⁴ Made by presidential proclamation.

The Huron National Forest, in Michigan, was created during the year, the 423,889 acres entered in Table includes 39,000 acres also reported the year, as added to the Michigan Forest. The duplication makes doubtful by this amount the gross-area elements for the two years.

The changes made by acts of Congress in the Absaroka, Gallatin, Lassen, Powell, Shoshone, and Teton Forests were to readjust the boundaries

between the Yellowstone, Lassen, and Bryce Canyon National Parks and adjoining national forests and to create the Grand Teton National Park. The addition made by Congress to the Missoula was in correction of an error in a previous bill. The additions made by Executive order to the Eldorado and Harney (the former under the authority of a specific act of Congress) brought within these units small adjoining areas of public lands found to

have sufficient forest values to justify their inclusion. The Monongahela changes were to exclude from the unit portions in which purchases have been found inadvisable, and to include new areas offering opportunities for desirable acquisitions. The Huron addition represents essentially the conversion of a former "purchase area" into an organized national forest.

While the major part of the land in the Huron still remains to be acquired, the new unit contains a substantial nucleus of Federal lands formerly included in the Michigan National Forest and a certain amount of lands acquired outside that unit. In connection with the establishment of the Huron, it was found advisable to exclude a portion of the area formerly embraced in the Michigan, since its acquisition is not deemed feasible. The resulting elimination appears in Table 6, under the Michigan. The latter unit is now confined to the northern peninsula of the State.

The rest of the changes shown in the table are all of very minor character and were due to a variety of considerations of administrative convenience.

What part of the public lands should be added to the national forests because of their actual or potential timber and watershed values should be determined at an early date. With the increasing scarcity of timber and the increasing importance of water conservation many areas previously thought of relatively low value should be considered anew. It is true that section 8 of the Clarke-McNary law authorizes the Secretary of Agriculture to ascertain and determine the location of public lands chiefly valuable for stream-flow protection or for timber production, which can be economically administered as parts of national forests, and to report his findings to the National Forest Reservation Commission; but a wide range of local interests are involved, and present jurisdiction over the lands rests in the Department of the Interior. However, the beneficial effects of regulated use under national-forest administration have been so widely and thoroughly demonstrated that there should be no difficulty in reaching a conclusion regarding the form of use under which certain classes of the remaining public lands will have the highest permanent economic and social value. Field officers of the Forest Service have examined and submitted reports upon 44 areas, con-

taining 1,264,330 acres of public land and estimated to support 2,333,000 board feet of timber, upon which action remains to be taken. Still other areas remain for consideration. Of the areas reported on, five have been approved by the National Forest Reservation Commission under authority of section 8 of the Clarke-McNary Act and referred by the President to Congress. No additions were made to the national forests last year under the procedure provided by that act.

LAND ACQUISITION THROUGH EXCHANGE

Additional exchanges were worked out with the State of Michigan which by the Government will acquire timber to State lands within national forests while the State will acquire public lands of the United States within existing or contemplated State forests. Thus the consolidation of both classes of public forests is aided. A further exchange with the State of South Dakota was initiated during the year. The exchanges initiated in earlier years are all progressing toward consummation. Through them the States of Washington, Oregon, California, Idaho, Montana, South Dakota and Michigan have been enabled to place widely scattered holdings, practicable for effective administration, with compact holdings easily ministered and of great public value. An exchange with New Mexico awaits a constitutional amendment. The remaining Western States apparently prefer to retain their present holdings or to use them as base for other selections.

The acquisition of private lands through exchange was facilitated by acts of Congress extending the provisions of the forest exchange act to privately owned lands within 6 miles of the exterior boundaries of national forests in the State of Montana, authorizing the exchange of privately owned lands within the Lincoln National Forest, in New Mexico, for reserved public lands in that State. During the calendar year 1928 a total of 89,798 acres was added to national forests through the exchange of 25,269 acres of national-forest land and \$272,371 worth of national-forest stumpage for 115,067 acres of private lands. The Secretary of Agriculture approved and referred to the Secretary of the Interior for further action new cases, offering 262,737 acres of privately owned lands in exchange for 22,054 acres of national-forest land.

36,006,000 board-feet of national-forest stumpage. Since the land-exchange legislation was enacted 391 exchanges have added 485,739 acres in return for 132,014 acres of national-forest land and \$1,020,678 worth of national-forest stumpage—a net addition of 353,725 acres. The national-forest stumpage granted will be more than offset by the mature stumpage on the acquired lands.

The Forest Service safeguards against serious reduction of county and Federal revenues by limiting to 10 per cent of the gross receipts in any State, and ordinarily to 10 per cent of the timber-sale receipts alone, the total value of the stumpage used in exchanges in any one year; and this necessitated the postponement of some desirable exchanges.

Privately owned forest lands within and contiguous to the national forests are in the main integral parts of the natural logging units or working circles with which the Forest Service is dealing. Frequently they constitute serious obstacles to orderly and sound plans of protection and utilization. Cut-over, slash-covered, and inadequately protected lands menace the national forests and increase the cost of protection. After the present stands of timber have been removed the probability is that the lands will be disposed of for grazing use or neglected, with ultimate loss of their potential value for forest production. Both the location and the diverse ownership of much of the land militate against its effective management independently of the national forests. There are almost 25,000,000 acres of non-Federal lands within the forests, of which roughly some 12,000,000 acres should be acquired, as well as certainly several million acres of contiguous outside land. The acquisition of this 15,000,000 to 20,000,000 acres raises a very large question of ways and means. One answer suggested by the act of February 1929, authorizing the exchange of reserved public lands in New Mexico for lands in the Lincoln National Forest. If that exchange is consummated, lands of great public value will be acquired, and lands which have been held open for private appropriation will pass to private ownership. Thus not one but two broad public purposes will be accomplished. The 190,000,000 acres of unreserved and unappropriated public lands offer other opportunities along this line.

LAND ACQUISITION THROUGH PURCHASE

Title was taken under the Weeks law, as amended by the Clarke-McNary law, to 189,474 acres, at a cost of \$891,209.29. The average cost per acre, \$4.70, is less by 44 cents than the previous average of all purchases.

Purchases totaling 464,208 acres, at an average price of \$3.85 per acre and creating a total obligation of \$1,786,461.15, were approved by the National Forest Reservation Commission during the year. Included was a small area of Pennsylvania virgin white pine and hemlock forest that is now made a part of the Allegheny National Forest, and that is almost unique as an example of the original stand.

The distribution by States of the lands fully acquired is shown in Table 7.

TABLE 7.—*Acres of timberland acquired in the fiscal year 1929 and total acquired to July 1, 1929, by States*

State	Acquired in 1929	Average price per acre, 1929	Total ac- quired to July 1, 1929
	<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>
Alabama.....	4,865	5.03	96,741
Arkansas.....	27,002	2.83	146,378
Georgia.....	44,216	4.76	244,952
Maine.....	252	6.00	33,361
Michigan.....	20,758	1.16	73,100
Minnesota.....	28,046	1.70	32,139
New Hampshire.....	9,584	8.64	460,474
North Carolina.....	844	5.54	370,495
Pennsylvania.....	39,769	8.56	291,337
South Carolina.....	266	6.08	42,378
Tennessee.....	6,548	6.02	372,958
Virginia.....	1,973	5.18	588,954
West Virginia.....	5,472	3.62	242,967
Total or average.....	189,575	4.70	2,996,234

The average cost of all lands fully acquired, not including overhead, has been \$5.11 per acre; the total, \$15,306,420.80.

The National Forest Reservation Commission approved the establishment of nine new purchase areas—the Osceola, Ocala, and Choctawhatchee in Florida, the Oneida, Flambeau, and Moquah in Wisconsin, the Keeweenaw in Michigan, the St. Croix in Minnesota, and the Green Mountain in Vermont. The Ocala and Choctawhatchee include long-established national-forest units created by the reservation of public lands; they are made purchase units to facilitate the

consolidation and rounding out of the present properties.

Several adjustments of the boundaries of purchase areas were approved by the commission. Those of the Monongahela, in West Virginia, were radically readjusted with a net area decrease of 47,743 acres. The Nantahala and Savanna units were combined and somewhat modified. The Catahoula unit in Louisiana was revised and its area increased from 50,000 to 78,700 acres. To include integrally related lands, the Ouachita purchase unit in Arkansas was extended by 200,000 acres. Numerous changes in the boundaries of the White Mountain National Forest in New Hampshire effected a net increase of 5,430 acres, while 380,000 acres were eliminated from the Pisgah, in North Carolina, to exclude large areas which are not purchasable.

While neither the Weeks law nor the Clarke-McNary law limits purchases geographically, the lands bought have been east of the ninety-fifth meridian, where the forest situation is acute, the need for public action urgent, the population and timber consumption largest, the number of important navigable streams greatest, the proportion of forest land assured of permanent timber growing smallest, and the acreage of publicly owned forest land relatively negligible. Under the Weeks law the major objective was the protection of navigable streams, though with timber production a natural concomitant. The Clarke-McNary law added timber production as a major purpose, but with watershed protection as an accompanying result, since all lands purchased must be on the watersheds of navigable streams. Along with these two closely allied major purposes the purchase policy furthers the effective participation of the Nation in the broad task of forest perpetuation through the development and demonstration of practicable methods of forest management on a large scale, and makes possible the coordination with timber production and stream-flow protection of such related uses as outdoor recreation and wild-life conservation.

Where watershed protection is the dominant consideration the national-forest units must be large enough to embrace appreciable parts of the watershed. If timber production is the first concern, the units must be of sufficient size to allow economy of operation. But where it is desired to stimulate private forestry by developing and demonstrating successful methods of man-

agement, a larger number of small units, well distributed, will accomplish most.

The original Weeks law program contemplated the acquisition of 1,000,000 acres in the White Mountains and 5,000,000 acres in the southern Appalachianians. But while this objective was being slowly and partially attained forest exploitation continued and was even accelerated. After an exhaustive inquiry the Senate select committee in 1924 recommended that timber production be made a primary objective of the purchase work, that the work be extended into new regions and that an enlarged purchase program be adopted. The ensuing Clarke-McNary law and the McNary-Woodruff law gave legislative effect to these recommendations as national policy. The present task is to give them adequate application.

As was stated in last year's report a survey of the situation and its requirements led to the approval by the National Forest Reservation Commission, early in 1928, of a program for the eventual acquisition of 9,600,000 acres of land, contingent, of course, upon the necessary concurrence of the States. Substantial purchases have since been approved by the commission. A resurvey indicates that to give full effect to the program ratified by the National Forest Reservation Commission a year ago will entail the purchase of 3,770,000 acres to consolidate previously existing national forests; the headwaters of navigable streams; 1,144,000 acres to consolidate previously existing national forests in Michigan and Minnesota; 1,300,000 acres within the approved or proposed new national forests to protect the headwaters of navigable streams; and 3,260,000 acres within the additional approved or proposed national-forest units in the southern pine region and the northern Lake States intended primarily to aid in timber production and to demonstrate forestry practice on approximately 9,475,000 acres told.

To carry out the program calls for a definite fiscal policy and plan, with other large, long-time governmental programs such as the public building program and the Federal highway program, the best results can be obtained under definite legislative authorizations covering from 5 to 10 year periods. This makes possible the maintenance of a trained and experienced in place of a fluctuating personnel, and continuous, orderly progress. The purchase work can be made

onomically and efficiently planned and executed under assurance of the future availability of funds. The 3-year authorization contained in the act of April 30, 1928, has been very helpful, but it expires with the fiscal year 1931. The enactment by Congress of a succeeding measure embodying a fiscal plan and authorization for a 10-year period would greatly facilitate the accomplishment of the whole project.

SPECIAL USES

At the close of the calendar year 1928, 33,310 special-use permits were in effect, of which 15,760 were free and 17,550 involved an annual rental charge. The free permits increased by 451; the pay permits by 429. Most of the free permits are granted to facilitate the use of other forest land resources; most of the pay permits for occupancy of hotel, resort, and private-cottage sites. Receipts totaled \$287,119.08.

CLAIMS AND SETTLEMENT

Favorable reports were made on 168 and unfavorable on 31 homestead claims. Most of the lands involved had been listed for entry under the present homestead act, and the unfavorable reports were usually because of noncompliance with the requirements of the law relating to residence and cultivation.

Favorable reports were made on 110 and unfavorable on 25 mineral claims. Attempts continue to employ the mineral land laws for purposes other than mineral development. Citizens were recently invited by circular letter to join California clubs which would obtain and use for recreational purposes desirable tracts within the national forests, to be located as mineral claims. Modification of the present laws to prevent such fraudulent practices without hampering legitimate development of the mineral resources is urgently required. A law which would give mineral claimants title to the body and the right to use so much of the surface as is needed in connection with the mining operations, but would retain title to the surface to the United States, would correct the evil.

COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

No projects were referred to or considered by the coordinating committee

on national parks and forests during the year. Some questions remain relating to the boundaries of the Yosemite and the Sequoia National Parks in California and the tentatively suggested Cliff Cities National Park in New Mexico, but they were not in such status as to permit of their further consideration by the committee.

The adjustment of the boundaries of the Yellowstone National Park recommended by the committee has been accomplished in part by the acts of Congress approved February 26 and March 1, 1929. The remaining proposals are to be considered by a special boundary commission, appointed by the President in pursuance of an act of Congress. The setting aside of the Grand Teton National Park and the boundary adjustments increasing the Lassen Volcanic National Park in California and the Bryce Canyon National Park in Utah have already been mentioned. A bill to create the Ouachita National Park from lands now parts of the Ouachita National Forest, in Arkansas, passed both Houses of Congress but was not approved by the President.

NORTHERN PACIFIC LAND-GRANT LEGISLATION

The right asserted by the Northern Pacific Railway Co. to select approximately 2,800,000 acres of indemnity lands within the national forests of the Northwest was terminated by an act of Congress which became law June 25, 1929. The law removed from the operation of the grants made to the railroad the lands in question, at the same time providing that the railroad shall be entitled to compensation for the lands if and when the right to compensation shall be established through decision of the courts. The law also declared a forfeiture of the unsatisfied indemnity selection rights of the railroad, with provision for the institution of court proceedings to determine the disputed questions of law and fact which arose in connection with the consideration of the case by the joint committee of Congress created to hear the evidence.

PROTECTION FROM FIRE

The number, size, and causes of fires on the national forests in the calendar year 1928, as compared with those of the previous year and the average of the past 5-year period, are shown in Table 8.

TABLE 8.—Comparison of fires on national forests, calendar years 1928, 1927, and 5-year average for period 1924-1928

	Number of fires			Percentage of total		
	1928	1927	Average 1924-1928	1928	1927	Average 1924-1928
Class:						
Burns of 0.25 acre or less.....	3, 873	3, 588	3, 868	55. 96	63. 02	53. 00
Burns between 0.25 and 10 acres.....	1, 914	1, 443	2, 025	27. 66	25. 35	27. 00
Burns of 10 acres and over.....	1, 134	662	1, 351	16. 38	11. 63	18. 00
Total.....	6, 921	5, 693	7, 244	100. 00	100. 00	100. 00
Cause:						
Railroads.....	281	297	328	4. 06	5. 22	4. 00
Lightning.....	3, 195	3, 074	3, 616	46. 18	54. 00	49. 00
Incendiarism.....	690	397	754	9. 97	6. 97	10. 00
Brush burning.....	230	163	234	3. 32	2. 86	3. 00
Lumbering.....	133	77	138	1. 92	1. 35	1. 00
Camp fires.....	717	596	705	10. 36	10. 47	9. 00
Smokers.....	1, 345	875	1, 179	19. 43	15. 37	16. 00
Miscellaneous.....	330	214	290	4. 76	3. 76	4. 00
Total.....	6, 921	5, 693	7, 244	100. 00	100. 00	100. 00

Calendar year	Total area of national-forest land burned over	Total damage of national-forest land burned over	Total cost fighting fire exclusive of time of forest officers
	<i>Acres</i>	<i>Dollars</i>	<i>Dollars</i>
1928.....	398, 900	833, 122	1, 193, 000
1927.....	170, 473	298, 733	646, 000
5-year average, 1924-1928.....	439, 818	1, 595, 977	1, 289, 000

On the whole the showing in 1928 fell below that in 1927, which bettered that of 1926 at practically every point. The number of fires covering 10 acres or more almost doubled, approaching the 5-year average; and the number of man-caused fires increased 42 per cent and exceeded the 5-year average. Of all classes of man-caused fires only those caused by railroads showed any decrease.

The area of national-forest land burned increased 134 per cent and rose to within 9 per cent of the average for the 5-year period, which included two bad years; the total damage exceeded \$800,000; and the fire-fighting expenditures (mostly on large fires) approached \$1,200,000.

The climatic conditions of 1928 were about what must normally be expected. Prolonged drouth, wind, and low humidity created an extremely dangerous situation in California; Oregon and Washington had for a time unusually high temperature and low humidity; a troublesome period occurred in Idaho and Montana after the season had supposedly been closed; and in the Southwest the season was abnormally long. On the other hand, summer

rains were unusually abundant during what is ordinarily the peak of the season in the northern Rocky Mountains and North Pacific States, and there was no such disastrous bunching of lightning fires as in 1926 wrought to terrible destruction in the Idaho white pine.

That great improvement has been made in the protective system with increasing experience and through unremitting effort for better organization, personnel training and management, financial management, provision of equipment, and control technique. It is evidenced by the declining percentage of the total area within forest boundaries that has been burned over annually by 5-year averages since 1910. The percentage for each period was as follows:

Period	Per cent
1910-1914.....	0. 75
1915-1919.....	. 60
1920-1924.....	. 29
1925-1928.....	. 28

The last percentage shown above covers only four years, since the 11-year record is not yet completed; the years are calendar, not fiscal, years. It is probable that when this year's losses

are fully known and averaged in they will raise the last percentage. The successive percentages suggest an approach to a stationary condition, beyond which little further improvement can be looked for unless the limiting factors that are slowing down progress can be discovered and removed.

Efficient fire control means having as few fires as possible, and holding those as small as possible. Much more must be done to prevent fires, by such measures as roadside clearing, informing and cautioning the public, and enforcing safety laws and restrictions. Many man-caused fires will start, however, even when prevention effort is greatly intensified; and there will always be the lightning fires. Ability to hold within the smallest possible limits each fire that does get under way is, therefore, fundamental for satisfactory protection.

Just as in a city, prompt discovery of each fire, speedy transmittal of the report of its location, instant starting of properly equipped and properly trained fire fighters for the scene, and swift movement in transit are of first importance. Much of the protective effort of the Forest Service has gone into providing for these essentials. They necessitate, of course, not only organization but also such accessories as lookout stations, telephone communication systems, roads, and apparatus. The inadequacy of the present equipment of the Forest Service with various of these accessories is brought out later. But however fast the action, when fires spread rapidly they can not all be caught and stopped while small.

Most of the fire losses, and usually by far the greater part of the expenditure for protection, result from large fires. Although, as Table 8 showed, five-sixths of all the 1928 fires were held to less than 10 acres each, the bulk of the damage was done by the fires which covered 100 acres or more. Every such fire is made the subject of subsequent inquiry, to discover why it was not held in closer check. The conclusions established regarding California were significant in several respects.

Fires that covered more than 100 acres each were responsible for nineteen-twentieths of the area burned over. Their after-study disclosed that three-fourths of the total area was covered by fires which it is not reasonable to expect to keep below 100-acre size, with existing means. The big losses and the heaviest fire fight-

ing expenditures in California are due to fires that start on areas of extreme inflammability. Largely these are covered with brush and grass, and largely they are outside the national-forest boundaries. Such fires spread so swiftly that suppression in their incipency is usually impossible. For fires which have gained marked headway control during the first night becomes the logical objective. But two-thirds of the area burned in California during the 1928 season was covered by fires that were not stopped the first night, and nearly half by fires of which first-night control can not be expected without advance construction of permanent fire lines and breaks. The need for protective improvements of this character has not as yet been adequately recognized in the provisions made for the work of protection.

SEASON OF 1929

Although the fire season of 1929 started comparatively late, the intensity and area of the fires in the California, north Pacific, and northern Rocky Mountain districts bid fair to make it one of the most disastrous in recent years. In all three of the Pacific Coast States the winter precipitation was greatly below normal, and in the north Pacific Coast States the spring rains also were less than usual. Many small fires occurred in California from the first of the year to May, when the forests were becoming very dry. By the end of June large fires were burning outside the national forests, and early in June one of these entered the Lassen Forest and burned over 1,500 acres before it was brought under control. Throughout August many fires occurred in all parts of California, with generally unfavorable weather conditions, especially in the first half of the month, when winds, high temperatures, and low humidity made control very difficult. In northern California there were many incendiary fires.

Little trouble was experienced in the north Pacific Coast States until July. During the latter part of July lightning storms in a period of extreme inflammability caused serious fires, and by the middle of August, 13 large fires out of control had burned over 35,000 acres of national-forest land in Washington and Oregon. Late in August the situation was still acute, with 92,000 acres burned on the Chelan and Colville Forests along the international boundary.

In the northern Rocky Mountain district the spring and early summer were cool and showery. Late in July the rapidly drying country and frequent lightning storms brought out the fire fighters in full force. In early August extreme inflammability created a situation of extraordinary hazard. The seriousness of the situation was increased by the occurrence of fires on the public domain outside the national forests, with the necessity for assistance in men, equipment, and supplies by the Forest Service. In the extremity the local forces were recruited by calling for assistance from other national-forest districts in which the danger was not imminent.

In the second and third weeks of August the situation rapidly grew worse. August 23 was reported as one of the worst fire days in the history of the district, rivaling the disastrous August 22 and 23 of 1910. Heavy gales whipped up the fires on six of the burning forests and caused new fires on three other forests to spread over an immense area in a few hours. One fire burning near Kalispell, Mont., on Forest Service and protective-association lands and on the Glacier National Park had covered on that day approximately 75,000 acres with extensive losses of improvements and property.

During July a very serious fire situation developed on the Superior National Forest, in northern Minnesota. Heat and low humidity had created extraordinary conditions; many of the swamps had become completely dry, the humus in the timber was "powder dry," and conditions generally were the worst in years. The most serious of the fires was beyond control for several days. Over 7,000 acres of national-forest lands were burned over, with a suppression cost of upward of \$28,000.

From the data available as this report is closed, the expenditures for fire suppression in the 1929 season will make necessary a very large deficiency appropriation. The activity of the fire prevention and suppression forces is indicated by the fact that only 10 per cent of the fires reached the size of 10 acres.

FOREST PROTECTION BOARD

Mention has been made in previous reports of the organization, by the chief coordinator of the Bureau of the Budget, of a protection board comprising representatives of the Federal bureaus responsible for the ad-

ministration and protection of forest lands. The regional boards organized under the central board have extended the work. A notable example was the creation of a joint board of fire review to analyze certain troublesome fires which concerned two Federal bureaus and a State forest service. Impersonal and painstaking analysis of the detailed history of individual fires, including all the measures employed in handling them, has proved a very constructive means of discovering how to improve the functioning of the national-forest protective force. The method should prove equally helpful in dealing with situations in which various Federal, State, and other agencies are concerned, and in which complete coordination of effort is essential.

The value of bringing into touch with each other the field representatives of the various Federal agencies that have to do with the protection of forest lands owned by the United States is obvious. A means is provided to enable them to correlate their efforts, to work out as joint problems the procedures desirable where cooperation can be advantageously employed, and to profit by interchanging information, pooling experience, and borrowing from one another methods of proved worth. Along with the improvement of field performance and the promotion of economy in the use of funds which the functioning of the forest-protection board is bringing about, the board is also undertaking a very important work of correlation through the study of the relative needs of the various classes of Federal property that have to be protected, and the formulation of protective plans based on a broad-gauge survey of the entire task of the Government in this field, seen as a whole. The board functions, of course, as a creation and subordinate agency of the Bureau of the Budget to which it reports. It is thus in position to be of great service in constructive fiscal planning in connection with its task of coordination.

AIR PATROL

From 1919 to 1927 use was made of aircraft for the protection of the national forests under cooperative arrangements between the Army Air Corps and the Forest Service. During the latter part of this period the Army Air Corps furnished the planes, and the Forest Service employed the pilots and mechanics, using forest officers as observers. In 1918 changed conditions

made it impracticable for the War Department to continue to furnish planes, and it became necessary for the Forest Service to contract with commercial aviation agencies for such aerial patrol as fire conditions might make necessary, these agencies furnishing the planes and operating personnel and the Forest Service providing observers as before. Insufficient time has passed to determine conclusively the relative advantages or disadvantages of the new plan, but present indications are that it gives the service needed at a somewhat lower cost.

RADIO

In the report for 1928 the use of radio in connection with national-forest protection was discussed, and an outline was given of the experiments inaugurated to solve, if possible, the technical problems encountered on the national forests. This work is being carried forward as planned. By the close of the present field season it is hoped that the possibilities which radio may have for communication in mountainous timberland, in connection with fire control, will be sufficiently determined to establish whether it has any important value. If with the right combination of wave lengths, arrangement of antenna, type of battery power, and other adjustments, radio equipment can be used effectively as a supplement to the telephone systems on the national forests, the problem of obtaining the equipment will arise. To provide the national forests on which bad fire conditions make such supplementary communication facilities urgently important will require an outlay estimated at between \$130,000 and \$190,000.

It is impossible to provide from the present appropriations adequate equipment of proved value, and badly needed. Motor equipment, water pumps, and tank trucks are examples of the things essential in modern methods of efficient fire control, of which the supply is entirely insufficient. If the radio is to be added to the list the need for additional funds will be still greater.

USE OF MACHINERY

In common with the industrial world the Forest Service is seeking to replace hand labor or multiply its productivity by the use of machinery and mechanical processes. It is possible to record developments of considerable importance.

In the report of the fiscal year 1927, mention was made of the use of a heavy draft animal and a special kind of plow to speed up the trenching operation which is necessary in most regions in stopping the spread of forest fires. Since that time a machine tool used in road building has been modified to answer the same purpose. When drawn by a light tractor, it has considerably more speed than a horse and plow, is much steadier, and is of course untiring. In the type of country to which it is adapted it is rated as the equivalent of from 50 to 100 men working with ordinary hand tools.

In the Pacific Northwest the size and number of snags on old burns and cut-over areas makes them an outstanding problem in forest protection. To stop the spread of a forest fire or to put a cut-over area in proper condition for protection, the snags need to be felled. It is almost impossible to stop a fire on an area covered by such standing snags because of the way they scatter fire over the heads of the fire fighters. To fell them by hand sawing is slow and costly. Holes bored in the base of a snag make it possible to fall it by blasting or burning, but hand boring is too expensive. Boring by machinery has been proved practicable, and the method is already employed in a small way. Electric power from portable generators drives portable electric drills which bore the holes. Wider use of the method is expected to have far-reaching results.

Another opportunity for the development of the use of machinery is in connection with the construction of firebreaks and the opening of trails in rough country. In California the heaviest type of logging tractor in combination with the heaviest type of road grader or special forms of drags is being used to crush and shove aside heavy growths of brush, which must be got out of the way in road building or firebreak construction. On ground which was not excessively rough a firebreak 40 feet wide was thus cleared at a cost of \$40 per mile, exclusive of depreciation on the machinery, as against a cost of \$450 per mile by the usual hand labor. In another case a firebreak 50 feet wide cost approximately \$125 per mile, and a simple motor road of the type needed for fire control was built in connection with it for \$75. Where the presence of rock made the use of the usual grader impossible a form of heavy drag was devised to follow the tractor, which could itself dodge the worst of the

rocks, and a firebreak was constructed in a critical area at approximately one-tenth the cost of handwork. Unfortunately much of the ground where firebreaks are most urgently needed is so rough and steep that no machinery yet developed can be used. Nevertheless, there is a large field for the use of the machinery that has been already successfully employed. In many parts of the country it will make practicable the construction of protective works the cost of which would otherwise be prohibitive. In the roadside clearing which must be done eventually as a means of fireproofing forests and watersheds such machinery will play an increasingly important part. Similar efforts to develop new appliances and machinery is going on in every national-forest activity which seems to offer opportunity for the use of mechanical devices to the advantage of the work.

Substantial progress has continued in using water in fire suppression, through the employment of portable power pumps and hand-power backpack pumps. A further significant advance has been made in this direction in the Pacific Northwest and in California through the development of tank trucks. In one of these experimental types a separate power unit capable of cross-country travel has made it possible to place water on fires which occurred some distance from roads in an unwatered country. The other types are a single unit designed to reach fires starting along roads. All have proved their worth by enabling suppression forces to catch fires which otherwise, by hand labor alone, would have become large. The

always-difficult problem of mopping up fires has been greatly simplified and the process much shortened. Existing appropriations make inadequate provision for the purchase of such very necessary equipment.

PROTECTIVE IMPROVEMENTS

That fire losses have been greatly increased by the lack of protective improvements has long been recognized. The fire seasons of 1927 and 1928 demonstrated this still more emphatically. Last winter the Forest Service completed an estimate of the protective improvements needed immediately on the national forests. This estimate is tabulated in Table 9. It does not include the protective improvement required for a special situation on the four national forests in southern California, but does include provision for the considerable new areas added to the national forests by purchase and by exchange.

To protect the forests effectively the regular force of fire guards must be augmented in times of extreme fire danger by a large force of emergency guards. These guards should be on duty at assigned points in advance of the actual outbreak of fires. If telephone lines, lookout houses, and other necessary structures are not available the guards are of relatively little use. Hardly a beginning has been made toward equipping the forests with a system of emergency fire improvement.

The estimate includes some provision for a system of firebreaks and roadside clearing outside of southern California. The need in this direction was made very clear by the severe losses in 1927 and 1928.

TABLE 9.—*Protective improvements needed on the national forests*

Class of improvement	Cost of additions and replacement of obsolete and worn-out improvements	New improvements needed			Total cost
		Miles or number	Unit cost	Cost of new construction	
Telephone lines.....	\$305, 000	12, 600	\$90	\$1, 134, 000	\$1, 439, 000
Firebreaks and roadside clearing.....	6, 400	6, 140	130	798, 200	804, 600
Lookout houses.....	36, 000	480	700	336, 000	372, 000
Towers and observatories.....	60, 200	305	800	244, 000	304, 200
Cabins for firemen.....	44, 000	1, 500	320	480, 000	524, 000
Barns.....	4, 500	450	230	103, 500	108, 000
Warehouses, tool storage, work shops, etc.....	29, 500	850	120	102, 000	131, 500
Fences.....	29, 000	700	160	112, 000	141, 000
Water development.....	3, 500	640	110	70, 400	73, 900
Pasture development.....		180	100	18, 000	18, 000
Total.....	518, 100			3, 398, 100	3, 916, 200

The estimate does not include roads and trails, which are of course essential in protection. That speed and effectiveness in fire suppression are directly controlled by the adequacy of the road and trail system has been demonstrated with increasing force in recent years. The present annual appropriation for minor roads and trails is \$3,000,000. At present costs, and at that rate of appropriation, the needed work of this character which is now planned will be completed 37 years hence. Meanwhile losses will be mounting through the destruction of merchantable timber and of scenic and recreational values; through flood damage, the impaired value of watersheds, and the conversion of timberlands into unproductive wastes.

The tabulated statement does not include range improvements or the structures and developments which are classed as administrative improvements, although both have an important relation to forest protection as well as to the utilization of forage and the general conduct of business.

PROTECTION FROM INSECTS AND TREE DISEASES

Tree-killing insects are always at work in the forests, but ordinarily not in such numbers as to necessitate special protective measures. It is becoming apparent, however, that greater attention should be paid to incipient infestations than has been given in the past; they should be regarded as comparable to small fires which should be discovered and attacked before they have time to spread widely; and the forests should be patrolled for insect infestations with sufficient intensiveness to head off epidemics.

Bark beetles are particularly destructive to our coniferous forests. When circumstances happen to favor a rapid development of the broods, extensive destruction of timber takes place over a widening area unless vigorous control measures are undertaken. Forest fires are often followed by beetle outbreaks, due to the enfeebled condition of the trees, which lowers their powers of resistance. In turn, the great quantities of dead timber left after a severe insect epidemic add to the fire menace.

Last year the most serious insect epidemics were in Montana and Idaho. In spite of the fact that 60,000 acres were treated in the spring of 1928, the infestation in lodgepole pine on the Heavenerhead National Forest, in Montana, continued to spread so rapidly that its control by direct attack with-

out very great and, it is ^{100%} believed, unjustified expenditures became evidently impossible. The present control measures, therefore, consist of establishing zones of control based upon natural open barriers and maintaining an intensive patrol in the timber outside of these zones, to pick up any infestations which may occur as the result of beetles crossing the barriers. The general drift of the infestation is south and east, and the present plan is designed to keep the beetles from reaching the valuable timber stands on the Madison National Forest and the Yellowstone National Park.

Another beetle infestation has been developing in lodgepole pine west and south of the Yellowstone National Park, in the Targhee, Wyoming, Cache, and Caribou National Forests. Intensive control operations were inaugurated in 1928 and are continuing. Since it was possible to start the control before the infestations got very much headway it is believed this attack has been checked.

In the north Idaho white-pine region there has been a growing infestation in white-pine stands on the Coeur d'Alene, Kootenai, and Kaniksu Forests. Control projects have been under way on the Coeur d'Alene and Kootenai Forests for the past two years, with good progress, but recent surveys show that new centers of infestation are building up. Quick action and considerable expenditures of control funds will be required if the situation is to be properly handled. The infestations on the Kaniksu are largely the result of the serious fires on that forest in 1926, and are so general in distribution that such control as is undertaken will have to be largely through timber sales.

On the Targhee National Forest, in Idaho, a very threatening bark-beetle epidemic of extensive proportions is being attacked, apparently with success, by a method developed locally by the forest officers. The trunks of infested trees are sprayed with oil and a match is applied. The fire runs up the trunks and kills the beetles in the bark of the standing tree. This method is far cheaper and more expeditious than felling and barking the trees. The cost has averaged about 50 cents per tree treated.

On the Shoshone Forest, in Wyoming, the spruce bud worm has heavily infested the Douglas fir timber in Cody Canyon, leading into the Yellowstone National Park. This insect is a defoliator, and if not controlled in one or two seasons will kill the trees by

stripping of their foliage. Some experimental control work was done this spring which indicated that the outbreak could probably be stopped if sufficient funds and proper equipment could be made available. The method of controlling these insects is by dusting or spraying the foliage with some form of poison. Since the trees are very tall, special apparatus is required to reach the tops. The work is accomplished by spraying with high-pressure spraying machines or by dusting from airplanes.

In Oregon and California the situation is markedly improved. For a number of years a very severe epidemic has been in progress on both public and private lands on the Modoc Forest, in California. The timber affected was so inaccessible and the infestation so general that it was not until last year, when a railroad was definitely assured through the area, that control measures became practicable. As the result of the contemplated railroad a sale of Government timber was made to an owner of a large acreage of infested private timber, which provided for the immediate logging of the infested trees from 15,000 acres of Government and private lands before the emergence of the beetles last spring. Partly in consequence of these control measures, partly through a decline in the infestation from natural causes, the present indications are that the infestation is now well in hand and further losses of timber should be small.

The treatment of an area of lodgepole pine adjacent to the Crater Lake National Park, to supplement control work done by the National Park Service, was continued. The present indications are that the spread of the insects has been checked. In and adjacent to the Fremont National Forest control work was continued in cooperation with timberland owners, and here also the outlook is more encouraging.

The technical methods followed in each case were recommended by the Bureau of Entomology. The best of cooperation is received from this bureau, which has been of invaluable assistance to the Forest Service in training its officers to recognize dangerous conditions when they are encountered, as well as in prescribing the action necessary for control.

The white-pine blister rust is advancing in the western forests and

constitutes a menace to the very valuable white-pine stands of a character so grave as to make the immediate inauguration and determined prosecution of protective measures a matter of almost incalculable importance. In a single region, that in which the species often called Idaho white pine is the most valuable tree in the present timber stands, the future production of this tree on about 1,500,000 acres of national-forest land is at stake. For control of the disease the eradication of the native wild currants is necessary. A 20-year program of eradication has been outlined, calling for an expenditure in this region of \$100,000 the first year and \$200,000 annually throughout the rest of the period. The per acre cost of carrying out this program is approximately \$2.70; it may, however, prove that as the work becomes well organized this cost can materially lowered. It is estimated that the difference in value between crop of white pine on the land and any other species that can be grown will amount to between \$400 and \$800 per acre. The undertaking of the control program must await the making of the necessary appropriation for the work.

TIMBER

The timber cut exceeded that of any previous year, with a total under sale contracts and land exchanges together of more than 1,500,000,000 board feet. The cash receipts exceeded \$4,000,000 for the first time, and increased \$783,000 over the previous fiscal year. All national-forest districts except Alaska contributed to the increase.

This expansion was not due to a change in policy. The well-established policy is not to press timber on the market unless it becomes necessary to salvage timber which is deteriorating in consequence of fires, insect attacks or other causes. The increase was due primarily to demands resulting from the liquidation of private stumpage. Operators who had exhausted their own stumpage extended their operations by purchases of Government timber, thus preserving their own good will and going-concern assets, utilizing for a longer period their fixed investments in mills and transportation, and helping to maintain communities. Other operators were preparing to cut private stumpage so intermingled with that of the Government that there would be a great economic waste in logging one without the other. I

either case it is sound public policy to make national-forest timber available.

The stabilization of industries and communities is a recognized objective in national-forest timber management. When established enterprises need timber to continue in operation, if it can be supplied from the national forests without overcutting them—that is, without taking the timber off faster than the management unit, or “working circle,” will grow more—it is made available at a fair price. The corollary of sustained yield is sustained industries.

In part, the increased use of national-forest timber is a result of the increasing efficiency of logging and lumber manufacturing. New types of machines and improvements in old types have made it possible to operate on areas previously considered inaccessible because of the high cost of logging them. The extensive replacement of the steam donkey engine by internal-combustion engine tractors, in the California pine region especially, has lessened logging costs and also has reduced the danger of fire. Each improvement in logging or milling efficiency adds to the area of timber in which logging is practicable, and thus gives more owners the desired opportunity to liquidate their holdings. If these holdings are within or adjacent to a national forest, pressure for the purchase of Government timber inevitably results, sooner or later.

Another factor in the increased cut of last year was the at least partial recovery of the lumber industry from its serious depression in the calendar year 1927. Such periods of depression tend to obscure the gradual but steady development of timber operations on the national forests. The increases in volumes cut and receipts during successive years are irregular. Viewed over a period of years, however, the timber business is manifestly advancing, through an average increase of between 8 and 10 per cent in the annual cut, toward the full sustained yield.

This moderate increase, under the policy of not aggressively forcing timber on the market, has as yet brought the cut up to its ultimate propor-

tions in only a few isolated localities. For the national forests west of the Great Plains, exclusive of Alaska, the cut during the calendar year 1928 was the equivalent of only 17½ board-feet per acre of timberland (which does not include such land as the pinon-juniper woodland of the Southwest), while for the eastern forests the cut was the equivalent of only 10 board-feet per acre. In both cases all forms of material taken out, whether saw logs or not, are included. When all the land is covered with growing stands the national forests can provide a permanently sustained annual cut at least six times the present. Taken by States, the national forests of South Dakota, with a present cut of 43 board-feet per acre of timberland, are probably nearest their sustained yield, and those of New Mexico, with a 1928 cut of less than 5 board-feet per acre of timberland, are the lowest in the West.

The eastern national forests, made up as most of them are principally of lands purchased after the merchantable stand of timber had been lumbered, afford at present relatively limited opportunities for timber sales. It is gratifying to record that their timber business last year showed an increase of about 50 per cent in receipts. Among the sources of this increase were the first winter's operations on a 15-year sale, chiefly of pulpwood, on the White Mountain National Forest in New Hampshire, and a sale of short-leaf pine saw timber on the Ouachita National Forest, Ark., to a company owning intermingled and adjacent timber. At the close of the year advertisement was being made of a sale of pulpwood and saw timber amounting to the equivalent of 196,000,000 board feet on the Superior National Forest, Minn. These national forests east of the Great Plains will contribute more and more as time goes on and as their stock of growing timber is built up and improved through skillful management toward meeting the wood needs of the industries and population of the regions in which they are located.

Tables 10, 11, and 12 present in detail the timber-sale business of the calendar year 1928.

TABLE 10.—Quantity and value of national-forest timber sold, by States, calendar year 1928

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	Board feet	Board feet	Board feet	Dollars	Dollars	Dollars
Alabama.....	70,000		70,000	157		157
Alaska.....	17,750,000		17,750,000	29,530		29,530
Arizona.....	166,937,000	461,000	167,398,000	377,671	465	378,136
Arkansas.....	15,288,000	172,000	15,460,000	86,329	173	86,502
California.....	668,719,000	1,810,000	670,529,000	1,753,363	1,214	1,754,577
Colorado.....	109,777,000	933,000	110,710,000	230,466	942	231,408
Florida.....	2,161,000		2,161,000	5,264		5,264
Idaho.....	82,102,000	4,615,000	86,717,000	206,451	4,251	210,702
Kentucky.....	5,000		5,000	22		22
Michigan.....	4,150,000		4,150,000	8,317		8,317
Minnesota.....	3,754,000		3,754,000	14,564		14,564
Montana.....	31,261,000	4,625,000	35,886,000	70,644	4,863	75,507
Nevada.....	1,324,000	236,000	1,560,000	1,753	200	1,953
New Hampshire.....	142,043,000		142,043,000	1,000,544		1,000,544
New Mexico.....	18,786,000	634,000	19,420,000	43,196	678	43,874
North Carolina.....	17,363,000		17,363,000	40,723		40,723
Oregon.....	999,109,000	3,076,000	1,002,185,000	2,956,690	2,013	2,958,703
Pennsylvania.....	2,015,000		2,015,000	7,088		7,088
South Dakota.....	37,291,000	350,000	37,641,000	170,604	368	170,972
Tennessee.....	8,268,000	109,000	8,377,000	11,203	117	11,320
Utah.....	59,457,000	1,130,000	60,587,000	126,688	1,189	127,877
Virginia.....	21,349,000	6,000	21,355,000	37,415	8	37,423
Washington.....	184,735,000	214,000	184,949,000	388,130	137	388,267
West Virginia.....	1,122,000		1,122,000	3,645		3,645
Wyoming.....	75,160,000	1,549,000	76,709,000	195,190	1,402	196,592
Total, 1928.....	2,669,996,000	19,920,000	2,689,916,000	7,765,647	18,020	¹ 7,783,667
Total, 1927.....	626,175,000	16,523,000	642,698,000	1,562,382	14,885	² 1,557,267

¹ In addition, minor products not convertible into board feet were sold, valued at \$22,629.² In addition, minor products not convertible into board feet were sold, valued at \$59,368.

TABLE 11.—Quantity and value of national-forest timber cut under sales, by States, calendar year 1928

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	Board feet	Board feet	Board feet	Dollars	Dollars	Dollars
Alabama.....	101,000		101,000	237		237
Alaska.....	40,246,000		40,246,000	62,893		62,893
Arizona.....	66,615,000	379,000	66,994,000	171,973	412	172,385
Arkansas.....	5,130,000	234,000	5,364,000	31,485	234	31,719
California.....	291,161,000	1,776,000	292,937,000	906,189	1,114	907,303
Colorado.....	48,877,000	1,128,000	50,005,000	129,723	1,133	130,856
Florida.....	1,773,000		1,773,000	5,610		5,610
Idaho.....	150,720,000	3,657,000	154,377,000	565,322	3,423	568,745
Kentucky.....	9,000		9,000	127		127
Michigan.....	4,216,000		4,216,000	7,427		7,427
Minnesota.....	6,238,000		6,238,000	25,482		25,482
Montana.....	27,095,000	3,255,000	30,350,000	67,496	3,396	70,892
Nevada.....	1,290,000	243,000	1,533,000	1,974	228	2,202
New Hampshire.....	6,914,000		6,914,000	37,526		37,526
New Mexico.....	16,269,000	695,000	16,964,000	35,938	727	36,665
North Carolina.....	11,522,000		11,522,000	29,196		29,196
Oregon.....	258,154,000	2,519,000	260,673,000	785,207	1,604	786,811
Pennsylvania.....	1,344,000		1,344,000	10,503		10,503
South Dakota.....	34,828,000	479,000	35,307,000	127,035	521	127,556
Tennessee.....	12,766,000	111,000	12,877,000	16,058	123	16,181
Utah.....	7,881,000	1,024,000	8,905,000	15,897	1,056	16,953
Virginia.....	10,705,000		10,705,000	30,764	2	30,766
Washington.....	271,699,000	200,000	271,899,000	570,060	121	570,181
West Virginia.....	489,000	2,000	491,000	1,791	3	1,794
Wyoming.....	43,696,000	1,174,000	44,870,000	115,384	1,045	116,429
Total, 1928.....	1,319,738,000	16,876,000	1,336,614,000	3,751,297	15,142	¹ 3,766,439
Total, 1927.....	1,075,433,000	16,188,000	1,091,621,000	2,969,196	14,277	² 2,983,473

¹ In addition, minor products not convertible into board feet were cut, valued at \$23,503.² In addition, minor products not convertible into board feet were cut, valued at \$8,484.

TABLE 12.—*Number of national-forest timber sales, classified according to amounts of sale, by States, calendar year 192*

State	\$500 or under, commercial sales	\$500 or under, cost sales	Total	\$501 to \$1,000	\$1,001 to \$5,000	Over \$5,000	Total
Alabama	13		13				13
Alaska	205		205	4	5		214
Arizona	914	240	1,154	3	5	3	1,165
Arkansas	44	69	113	1	1		118
California	547	316	863	4	17	13	897
Colorado	672	182	854	5	9	5	873
Florida	83		83				83
Idaho	925	1,543	2,468	4	12	7	2,491
Kentucky	2		2				2
Michigan	53		53	2	2		57
Minnesota	171		171	1	2	1	175
Montana	647	1,089	1,736	2	8	2	1,748
Nevada	56	94	150				150
New Hampshire	122		122			1	123
New Mexico	842	411	1,253	2	5	2	1,262
North Carolina	308		308	2	3	1	314
Oregon	558	573	1,131	1	7	9	1,148
Pennsylvania	9		9	1		1	11
South Dakota	309	70	379	1	16	7	403
Tennessee	247	51	298		1		299
Utah	286	638	924	2	3	1	930
Virginia	421	5	426	2		1	429
Washington	176	59	235	5	8	12	260
West Virginia	11		11		1		12
Wyoming	313	290	603		8	3	614
Total, 1928	7,934	5,630	13,564	42	113	72	13,791
Total, 1927	7,462	4,970	12,432	60	105	51	12,648

PLANTING

Forest lands that have been badly burned, or logged by some of the more destructive methods, can be made to grow new crops of timber only by planting. The ability of the forest to perpetuate itself has been lost. There are more than 2,100,000 acres of such lands within the national forests. Only a small beginning has been made on the job of planting them. The main effort of the Forest Service has been to prevent the increase of this area through forest fires; and many millions of acres of land with scattered seed trees have had natural young stands established on them. But the 2,100,000 acres lack seed trees, and the natural return of the forest through gradual seeding and advance from the borders is exceedingly slow. The restoration of these lands to productivity is an urgent public need.

Nearly 50 per cent more land was planted in the national forests in 1928 than in any previous year during the past decade. In part this was due to the patriotic interest of organizations which, realizing that the rate of progress in national-forest planting work in their regions was wholly inadequate,

voluntarily provided funds for increasing it. In Michigan and in Washington these contributions enabled the Forest Service to plant nearly 5,000 acres more than would otherwise have been possible. The \$60,000 increase in the appropriation for planting also added substantially to the area planted.

By a special act, \$20,000 of the planting appropriation was made available for the purchase of land to establish or enlarge nurseries. A nursery site was purchased and a nursery established near Susanville, Calif., and land was obtained for urgently needed enlargements of the nurseries at East Tawas, Mich., and Halsey, Nebr. To enlarge the Monument nursery, on the Pike National Forest, Colo., suit was filed to condemn land the direct purchase of which proved to be impossible because of technical flaws in the offered title. A nursery was also established on the Medicine Bow National Forest, Wyo. Nursery establishment or enlargement is the first step in materially enlarged planting activities.

The action taken in Colorado and Wyoming has been taken with a view to planting extensive old burns on the watersheds from which the cities of

Denver and Halsey, respectively, secure their material supplies. The enlarged nursery at East Tawas, Mich., will provide stock for planting 10,000 acres annually of the denuded lands on the Huron National Forest. The enlargement at Halsey, Nebr., was chiefly to further the cooperative production of nursery stock for distribution by the State under the terms of section 4 of the Clarke-McNary Act. The California nursery will supply stock for the planting of burns on highly productive pine lands on the national forests in that State. When these new or enlarged nurseries are producing trees of the necessary kinds and sizes, the area which can be planted annually under the existing appropriation will be between 20,000 and 25,000 acres. At this rate the planting of the 2,100,000 acres of denuded timberland now within the national forests can be completed in about 100 years. But the purchases of new land by the National Forest Reservation Commission is constantly adding to the acreage. Because of their location with reference to industries and population the prompt restoration to productivity of many of these acquired areas is even more important than the reforestation of some of the burns in the western national forests. The National Forest Reservation Commission has already approved for purchase a total of over 142,900 acres in the Upper Peninsula of Michigan and in northern Wisconsin. Of this at least 70,000 acres should be planted. Similarly, in the Allegheny National Forest in Pennsylvania there are 60,000 acres of highly productive land which at present is growing only tree weeds and bushes, but which should be producing spruce or other valuable pulp or timber species. The enlargement of the planting program of the Forest Service to bring it into balance with other activities and with the purchase program contemplated by the Clarke-McNary Act is urgent.

TABLE 13.—*Planting and sowing on national forests, by States, calendar year 1928*

State	Area planted	Area sown	Total
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Michigan	11, 417. 85	-----	11, 417. 85
Washington	1, 416. 00	-----	1, 416. 00
Idaho	1, 343. 00	-----	1, 343. 00
Nebraska	1, 302. 70	-----	1, 302. 70
Colorado	1, 237. 12	2. 00	1, 239. 12
Minnesota	953. 50	-----	953. 50

TABLE 13.—*Planting and sowing on national forests, by States, calendar year 1928—Continued*

State	Area planted	Area sown	Total
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Oregon	664. 00	-----	664. 00
Montana	167. 48	-----	167. 48
Wyoming	103. 52	-----	103. 52
West Virginia	88. 10	-----	88. 10
North Carolina	45. 00	2. 00	47. 00
Pennsylvania	38. 40	-----	38. 40
California	34. 74	-----	34. 74
Virginia	11. 30	-----	11. 30
Tennessee	-----	8. 25	8. 25
Oklahoma	2. 50	-----	2. 50
Total	18, 825. 21	12. 25	18, 837. 46

RANGE

GENERAL RANGE AND LIVESTOCK CONDITIONS

Practically throughout the western range country the year was abnormal from the standpoint of the livestock man. As a rule the winter of 1927-28 provided adequate moisture, but cold spring or hot and dry summer weather curtailed the production of forage nearly everywhere. Nevertheless, livestock came through the year in fair to excellent condition; but in many localities it was necessary to take the animals off the range earlier than usual. Their good condition in spite of the unfavorable growing season was partly due to more conservative stocking, better handling, and the removal of trespassing wild horses.

The winter of 1928-29 was very severe in the central Rocky Mountain region. Heavy snows and cold weather caused severe losses and increased the wintering costs. On the other hand, the heavy precipitation greatly enhanced the prospects for the spring and summer. Excellent prices in 1928 and the early part of 1929 more than offset in most localities the rather adverse physical conditions. Except for a short period in the fall of 1928 cattle prices increased steadily over those of previous years, and wool and mutton remained fairly high. Since weather and market conditions combined to cause heavy sales of cattle of all classes, the depleted condition of the breeding herds was not materially bettered.

The very serious financial straits in which a large percentage of the western stockmen were involved for a considerable period have been remarkably improved during the last two years, and the livestock business is approach-

ing a state of normal prosperity. The present economic conditions continue for two or three years longer the offered by the industry will en largely recovered.

constructed on the basis of the national forest made of the national forest the calendar year 1928 is shown in Table 14.

TABLE 14.—Grazing permits issued and number of stock grazed on the national forests, by States, calendar year 1928

State	Cattle, horses, and swine				Sheep and goats		
	Permits issued	Stock grazed			Permits issued	Stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Alabama.....	3	34	2				
Arizona.....	1,085	187,463	2,231	460	120	288,636	1,766
Arkansas.....	20	202					
California.....	1,872	149,481	5,837	212	365	441,370	2,752
Colorado.....	2,979	277,814	5,081	60	881	1,050,609	421
Florida.....	4	152			4	1,034	
Idaho.....	2,844	119,525	8,973		1,012	1,335,911	250
Montana.....	1,942	119,943	9,564		481	602,113	90
Nebraska.....	36	11,265	590				
Nevada.....	364	51,085	2,284		139	316,538	
New Hampshire.....	20	129	35				
New Mexico.....	1,907	81,065	3,446	168	294	227,651	10,491
North Carolina.....	56	278	13	131	16	240	
Oklahoma.....	50	2,489	75				
Oregon.....	1,032	84,165	3,404		470	648,117	200
South Dakota.....	526	22,399	1,035		25	20,180	
Tennessee.....	23	183	2		6	224	
Utah.....	4,016	111,253	4,302	175	2,157	757,890	1,100
Virginia.....	51	539	12		4	103	
Washington.....	359	11,026	506		135	161,513	
West Virginia.....	11	106	4		38	909	
Wyoming.....	767	105,313	4,560		310	656,383	
Total, 1928.....	19,967	1,335,903	51,956	1,206	6,457	6,509,421	17,070
Total, 1927.....	20,871	1,403,192	55,629	1,002	6,129	6,376,838	18,046

The decline in 1928 from the number of cattle and horse permits and cattle and horses grazed in 1927 continues a trend that has been in evidence since 1919. In the 10-year period permits have fallen from 32,528 to 19,967, or 39 per cent, and the number of cattle from 2,135,527 to 1,335,903, or 37 per cent. On the other hand, for sheep a low point was reached in 1925. In the seven years 1919-1925 the number of permits declined from 6,624 to 5,835, or 12 per cent; the number of sheep, from 7,935,174 to 6,162,263, or 22 per cent. In 1928 11 per cent more permits were issued than in 1925, but 2.5 per cent fewer than in 1919. The number of sheep in 1928 was 5.6 per cent greater than in 1925, but 18 per cent less than 10 years ago.

These changes in grazing use have been primarily due to (1) the overburdening of many forest ranges during the war, which necessitated marked reductions to allow them to recuperate; (2) the postwar depres-

sion, with its forced retrenchment and liquidation; (3) the more rapid recovery in the sheep industry, with its consequent incentive for cattle permittees to transfer to the sheep business; (4) the recent heavy demand and high prices for cattle as well as sheep, which have influenced cattlemen, particularly, to sell heavily rather than replenish their herds; and (5) the more conservative stocking of the ranges to protect more adequately their forest, forage, and watershed values.

The reports of local forest officers have emphasized the smallness of losses from shortage of feed. This good showing demonstrates the importance of stocking conservatively enough to have adequate forage during bad periods.

Stockmen would generally rather have adequate feed for a restricted number of livestock than run large herds with no assurance of adequate forage during drouth periods or severe winters. The greatly increased calf

and lamb production respectively, see the rate of growth that applies. The abundant feed are convincing as, moreover, the conservative stocking benefits the livestock operator as well as the range, the forest, and the watershed.

STABILIZATION OF RANGE USE

With the return of prosperity in the livestock industry the demand for forest range grows greater. The readily available range that can be economically used has long since been fully allotted. To provide for new applicants, the larger permittees have been cut down as far in many cases as it is practicable to go. The increased investments in dependent ranch properties and the increased values of livestock enterprises make reductions in the grazing permits used in connection with these properties very doubtful public policy. In many communities distribution has gone so far that the forests have been closed to new applicants.

Some of the larger permittees have urged that the policy of closing national forests to new applicants be widely applied and that the existing permits be maintained at approximately their present size. This demand clashes with the demand from outside stockmen for a share in the use of the ranges. It is firmly believed

that under no circumstances should vested rights be established which would prevent reasonable adjustments to admit qualified applicants, or which would interfere with the full coordination of all the forest uses. On the other hand, reductions below the economic herd limit would not, it is believed, accord with sound public policy. By economic herd limit is meant the number below which the operator can not reduce and maintain a reasonably profitable enterprise.

The 10-year term permits issued in accordance with the policy of October, 1925, go as far in stabilizing the use of the range as is considered justifiable. These permits specify the number of stock which may be grazed during the period of the contract, subject to a reduction of not more than 10 per cent for distribution to other range users or qualified applicants, but subject to protection reductions at any time and in any amount necessary to safeguard the range and other forest resources. Term permits cover 47½ per cent of the cattle and 61 per cent of the sheep grazing on the national forests. Much more stock might graze under term permits, but the owners feel their tenure is sufficiently secure under annual permits and do not care to apply for term permits. The stability of range use during the last 20 years is fairly indicated in Table 15.

TABLE 15.—*Number of permits and number of stock grazed in the national forests of the six western districts in 1909 and in 1928*

Class of stock	Permits	Stock	Average per permit	Area in national forests	
				Total	Usable
Cattle, horses, and swine:	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Acres</i>	<i>Acres</i>
1909	22, 163	1, 585, 905	72	161, 534, 792	¹ 101, 212, 000
1928	19, 779	1, 387, 249	70	132, 442, 081	83, 320, 520
Sheep and goats:					
1909	5, 074	7, 819, 594	1, 541		
1928	6, 389	6, 523, 981	1, 031		

¹ Area estimated.

The average number of cattle per permit is approximately what it was 20 years ago (72 head in 1909 and 70 head in 1928), but the average number of sheep has decreased from 1,541 to 1,021 head, a decline of 34 per cent. This decline is considered a healthy development in view of the fact that the average permit is still above the economic herd limit. Economic con-

ditions largely account for the change. The sheep business in the West has been undergoing a modification. The great increase in the number of farm flocks has resulted in a larger number of owners, each with fewer and better-cared-for sheep. The larger operators have had to reduce their herds because of high prices of winter feed and the decrease in productivity and in acreage

of spring, fall, and winter range. With these changes in economic conditions distribution must keep pace.

While the total number of cattle, horses, and swine, and of sheep and goats was less in 1928 than in 1909, the usable area in 1928 was less. In fact the use in 1928 was more intensive than in 1909, for reduced to a cow basis (that is, using the accepted ratio of 5 sheep as the grazing equivalent of 1 cow) the average area per head of stock was 32 acres in 1909 as against 31 acres in 1928.

CHANGES IN CLASS OF STOCK

The demand for additional sheep range and the willingness of sheepmen to pay high prices for ranches and improvements used in connection with cattle permits have materially cut into some former cattle range.

The Forest Service has been urged not to allow cattle permits to be converted to sheep permits. The service position has been uniformly that the suitability of the range for the class of stock applied for and the real economic effects upon the established industries should be the governing considerations. Under this policy relatively few cases have arisen in which it was necessary to disapprove applications for changes that were administratively feasible. On the other hand, the Forest Service has felt justified in discouraging demands resulting from temporary economic conditions which if responded to would seriously affect the stability of the local livestock industry.

RANGE MANAGEMENT

The increasing demand for grazing privileges makes necessary increasing attention to the proper management of the forage resource. To this end, range-management plans are being worked out comprehensively. They analyze the grazing and related problems of each range unit, set up the management objectives, and specify the manner of use called for to attain the desired objectives. They determine

the distribution of stock that can be carried, the grazing season, and the distribution necessary to use the forage evenly. Their object is to secure the greatest use of the forage resource that is consistent with its conservation and coordination with other forest resources. They embody the best practices that have been developed by experiment and test. They incorporate the knowledge obtained by research regarding the stage of development at which the plants on each range may be safely grazed, the measures necessary to allow depleted ranges to recuperate, the best methods of developing water, the best salting practices, successful means of eradicating poisonous plants, the control of livestock diseases and of range-destroying rodents, and like matters.

Management plans have now been prepared for approximately 70 per cent of the range units on the national forests. Definite provision is made in each forest officer's schedule of work for carrying out the prescribed measures. Many instances of the resulting benefits could be cited. One forest supervisor reports that by doubling the number of salt grounds, opening up parks and trails, and reducing horse trespass the carrying capacity of one division of his forest was increased 25 per cent, with an improvement both as to the grade and the condition of the stock grazed. On another range the construction of trails and opening up of parks made it possible to provide range for two bands of sheep in place of one. In a third case the carrying capacity of a range was increased from 850 to 1,100 head through the construction of drift fences, posting additional salt grounds, and putting into effect a rotation system of grazing.

LOSSES OF LIVESTOCK

The economic waste represented by losses of livestock due to poisonous plants, predatory animals, and other causes is of increasing importance as the demand for range grows in intensity. Game birds and animals also are destroyed. The domestic livestock losses in 1928 are shown in Table 16.

TABLE 10.—*Respectively, losses on national forests, 1928*
Losses. The

District	From poisonous plants		From predatory animals, disease, and other causes		Total	
	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats
1.....	250	3,346	632	13,099	882	16,445
2.....	2,468	3,849	2,085	21,191	4,553	25,040
3.....	653	1,161	4,821	4,677	5,474	5,838
4.....	2,232	9,637	1,505	43,085	3,737	52,722
5.....	431	1,682	859	9,070	1,290	10,751
6.....	181	3,003	543	13,218	724	16,221
Total.....	6,215	22,678	10,445	104,340	16,660	127,018

To the close of the calendar year 1928, approximately 12,500 acres of poisonous plants had been eradicated, at a cost of \$59,753. Control measures were concentrated upon poisonous larkspurs (*Delphinium* spp.), which do by far the greatest harm to cattle. There remain approximately 373,000 acres needing treatment. A specific example will serve to illustrate the work and its benefits. On the Gunnison National Forest, in Colorado, 7,165 acres of range had become infested with poisonous larkspur when grubbing was undertaken. There has been grubbed to date a total of 1,716 acres, at a cost of \$5,728. Before control measures were undertaken the average number of cattle lost annually from larkspur was 127 head, valued at \$6,350. The number lost last year was 64 head, valued at \$3,200, or a saving of approximately \$3,150 annually through the improved condition of the range.

While poisonous plants are widely distributed, severe stock losses are usually caused within limited sites where the plants find especially favorable conditions for their growth in relatively large quantity. This makes control measures practicable at a cost that is soon more than offset by the livestock saved and by the increased carrying capacity of the range made available. The Bureau of Animal Industry at its experiment station near Salina, Utah, is doing splendid work in determining the toxic properties of range plants and in developing remedial measures for treating animals poisoned. The Forest Service has the responsibility for developing and applying control measures on the range, which the Government as landowner should bring into fully productive condition.

The losses among domestic livestock on the national forests from predatory animals in 1928 represented a

value of \$1,739,765. The economic value of game birds and animals destroyed was also great. The Bureau of Biological Survey develops and applies methods to destroy predatory animals on Federal lands, and in cooperation with interested agencies is extending this work to State and private lands. The economic importance of the work calls for enlarging it greatly. An urgent obligation rests upon the Federal Government to reduce the losses suffered from such causes by the stockmen, who are now paying over \$1,700,000 a year for use of the national-forest ranges.

RANGE IMPROVEMENTS

To control grazing satisfactorily, so as to obtain uniform and proper utilization of the forage, adequate range improvements are required. Often boundary fences are the only practical means of eliminating trespass and keeping stock within allotments. Approximately 10,728 miles of boundary and drift fences have been constructed. For the last three years all of the Federal improvement funds available have been concentrated in the southwestern forests, where the relatively smooth topography makes fenced control most necessary. About 1,430 miles of fences have thus been constructed. The fences still needed approximate 45 per cent of the present mileage, but the program has progressed far enough to demonstrate how much better regulation of the range use they make possible. In many instances impending heavy reductions in the number of livestock to check damage to forage and timber growth have been avoided, and the cost of handling stock has been materially reduced.

The situation with respect to range improvements is shown in Table 17.

TABLE 17.—Range improvements constructed on national forests to December 31, 1928

Item	National-forest district						Total
	1	2	3	4	5	6	
Boundary and drift fences..... miles.....	375	818	5,227	2,308	1,236	761	10,728
Water development..... number.....	265	374	38	737	486	386	2,286
Driveways..... miles.....	1,087	1,279	.....	605	44	466	3,481
Bridges..... number.....	25	16	17	28	7	15	108
Trails..... miles.....	1	.....	.....	107	26	52	186
Corrals..... number.....	68	77	30	47	184	131	537
Cabins..... do.....	36	.....	.....	3	191	77	307
Pastures..... do.....	15	.....	.....	8	415	1	439
Poison eradication..... acres.....	95	8,220	230	3,454	648	76	12,723
Salt troughs..... number.....	2	.....	.....	25	1,492	1,400	2,919
Cost met by stockmen..... dollars.....	91,685	86,110	2,199,635	116,623	332,185	142,183	2,968,421
Cost met by Federal Government..... do.....	201,707	124,089	172,831	132,546	48,440	46,298	725,911
Total..... do.....	293,392	210,199	2,372,466	249,169	380,625	188,481	3,694,332

RANGE IMPROVEMENTS NEEDED

Boundary and drift fences..... miles.....	270	262	2,850	371	317	736	4,806
Water development..... number.....	328	168	395	814	628	348	2,681
Driveways..... miles.....	.....	.....	.....	206	.....	99	305
Bridges..... number.....	27	.....	1	27	3	14	72
Trails..... miles.....	18	.....	90	153	20	.....	281
Corrals..... number.....	3	2	119	63	4	27	218
Cabins..... do.....	16	.....	.....	13	3	22	54
Pastures..... do.....	.....	.....	.....	15	42	.....	57
Poison eradication..... acres.....	6,175	74,193	250,971	10,985	2,827	809	345,930
Salt troughs..... number.....	249	.....	.....	.....	1,794	1,521	3,564
Cost to be met by stockmen..... dollars.....	577	34,774	380,200	137,953	43,796	73,602	670,902
Cost to Federal Government..... do.....	83,475	50,058	455,000	155,564	63,515	155,083	962,695
Total..... do.....	84,052	84,832	835,200	293,517	107,311	228,685	1,633,597

The stockmen have contributed four-fifths of the cost of the improvements hitherto constructed. In view of the benefits which they derive therefrom they will doubtless continue to construct many of those urgently needed and most valuable to them, for which Government funds are not available. The appropriation available for constructing and maintaining necessary range improvements during the fiscal year 1930 is \$85,000. This will not permit of much progress toward providing the extensive system of improvements needed.

Rodents and predatory animals continue to do great damage. It is hoped that the Bureau of Biological Survey will be allotted funds with which to eradicate rodents and predatory animals on the forests as well as on other public lands. Detailed information regarding the requirements for such control is being gathered.

GRAZING TRESPASS

Table 18 indicates the development and changes that have taken place in the grazing-trespass situation during the last 15 years.

TABLE 18.—Summary of grazing trespass, fiscal years 1914 and 1919, calendar years 1924 and 1928

Year	Cases pending at beginning of year	New cases during year	Total cases	Increase over 1914	Cases settled								Cases pending at close of year	Amount collected per case	
					Dismissed		Prosecuted		Innocent		Wilful				
					Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent			
1914	44	145	189		22	12	28	15	74	39	7	4	58	30	25
1919	112	586	698	269	64	9	77	11	320	46	94	14	143	20	75
1924	355	793	1,148	507	191	17	49	4	487	42	65	6	353	31	14
1928	183	600	783	314	70	9	3	(1)	398	51	154	20	157	20	29

Less than half of 1 per cent.

The number of trespass cases increased until 1924; they have since steadily declined, but are still much higher than in 1914. This is partly because of the increased demand for range and partly because of the stricter standards of grazing administration that have gradually been applied.

The impounding regulation, adopted in 1925, has proved to be a most effective means of controlling the trespass situation and accounts in large measure for the decline in trespass cases since that time. Under this regulation forest officers are given authority to round up stock in trespass and to dispose of them if after notification the owners fail to redeem the animals. Permittees generally favor this regulation. Its application is handicapped at present by lack of provision for replacing the Forest Service funds used in rounding up the stock from the receipts derived from the sale of trespassing animals. Legislative authority to do this is highly desirable.

Under the impounding procedure the number of wild horses has been materially decreased. Only 17,625 horses were reported in 1928, as against 24,376 in 1927. If more use can be made of the impounding regulation the trespass problem can be ended within a few years.

RECREATION AND GAME

Recreational use of the national forests touched a new high point in 1928 with an estimated total of over 23,000,000 visitors, made up of 385,518 special-use permittees and guests, 1,381,595 hotel and resort guests, 1,845,693 campers, 2,937,511 picnickers, and 16,458,680 transient motorists. Use of the forests by the last-named class was, of course, incidental and casual, but entailed a heavy obligation of supervision and provision of certain camping facilities.

The number of camp grounds either newly improved or further improved during the year was 228, and the cost was \$41,047. The improved camp grounds now number 1,186, but many should have new or additional equipment, and over 300 areas have not yet been provided with any facilities. The total cost of the improvements has been \$282,467, of which \$47,984 has

been contributed, in cash, material, or labor, by private or public cooperation.

Arrangements for a more exhaustive study of the Mount Hood area, in Oregon, were made following the report of the special committee the appointment of which by the Secretary of Agriculture was mentioned a year ago. A comprehensive plan for the development of this area is being prepared by men of outstanding experience in such problems. The Mount Hood situation is merely an example of a condition which is rapidly developing in other national forests. The increased leisure of the American people, the growth of automobile and other travel and of interest in outdoor things, the changes in modes of life which accentuate the need and demand for greater recreational facilities, all tend to enlarge the social and economic importance of the national forests as public playgrounds and treasure houses of scenic, wild life, and other natural values. A large responsibility is thus created for the conservation and development of such values in proper coordination with timber production, stream-flow protection, and like forms of usefulness. Sound technical planning and direction of development is necessary to assure against unwise occupancy or modification of notable areas.

The year marked the initiation of steps to preserve permanently within the national forests specimen areas of virgin timber representing the major forest types of each region, so that there may be preserved for scientific reference and study a well-chosen series of examples of the biological balances or complexes which originally obtained. Promiscuous recreational use of such areas would alter their character, and so defeat their purpose, but to provide for the forms of recreation for which wilderness surroundings are essential a second series of much larger areas is now being selected and established, within which primitive conditions of subsistence, habitation, transportation, and environment will permanently be maintained to the fullest practicable degree.

The result of the annual estimates made by forest officers of the number of big-game animals and beavers on the national forests is presented in Table 19.

TABLE 19.—*Number of big-game animals and beavers on national forests, by States, estimated as of December 31, 1928*

State	Beaver	Antelope	Bear		Caribou	Deer	Elk	Moose	Mountain goat	Mountain sheep
			Black or brown	Grizzly						
Alaska.....	3,785		16,100	² 2,500	20	60,350	10	550	9,500	2,000
Alabama.....			25			200				
Arizona.....	187	2,401	402	10		62,551	1,016			288
Arkansas.....						1,500				
California.....	225	772	11,200			245,400	191			675
Colorado.....	43,818	115	2,598	16		30,958	8,976		10	3,721
Florida.....			25			650				
Idaho.....	16,004	2,430	5,396	127		60,824	8,431	598	2,934	1,508
Michigan.....	6		50			175				
Minnesota.....	6,020		1,455		3	8,500		2,276		
Montana.....	18,150	520	5,713	490		50,220	11,639	1,257	4,082	2,212
Nebraska.....	2					50				
New Hampshire.....	4		800			3,200				
New Mexico.....	1,402	1,042	909	16		48,610	227			175
Nevada.....	326	220				6,125				180
North Carolina.....			100			4,403	43			
Oklahoma.....		11	5			300	350			
Oregon.....	5,192	75	6,992	1		76,370	6,685	9		45
Pennsylvania.....	50		200			1,350	15			
South Dakota.....	1,449	396				4,339	1,106			
Tennessee.....			16			118				
Utah.....	4,123		449	6		40,574	2,831			190
Virginia.....			500			58	75			
Washington.....	8,800		7,470	100		28,363	9,019		2,772	10
West Virginia.....			200			30				
Wyoming.....	8,084	512	1,626	181		12,785	27,604	2,281		2,820
Total.....	117,627	8,494	52,231	3,447	23	748,003	78,218	6,971	19,298	13,824

¹ Black bear only.² Includes Alaska brown bear.

The national forests contain over 100 State game refuges and 16 Federal refuges, covering all told more than 20,000,000 acres. Elsewhere the forests are open to the taking of game and fish, within the limitations prescribed by the general game laws of each State.

Forest officers cooperate extensively with the State authorities in game-law enforcement. In 1928, 276 cases were referred to State officers for prosecution, with 190 convictions. Forest officers themselves prosecuted 181 cases, resulting in 88 convictions. They also issued 5,584 game licenses and examined 31,144 licenses.

While the State laws govern the taking of game and fish on the forests, the wild life is one of the forest resources administered for the use and enjoyment of the public. Federal ownership and administration of the land aims at obtaining the greatest possible beneficial use of all resources, and this gives game administration a definite place in administrative planning and activities.

As was stated in last year's report, the major problems of national-forest game administration concern (1) methods of increasing the supply of game

where it has become depleted, (2) reliable estimates of the amount of game on each forest, (3) reliable estimates of the game-carrying capacity of each forest, and (4) methods of holding the number of game animals in balance with carrying capacities.

Planting game animals on areas where valuable species have been exterminated is one of the ways of increasing the game population. An example is the placing last year on the Medicine Bow National Forest, in Colorado, and on the Wichita National Forest, in Oklahoma, of a few mountain sheep obtained by donation from the Dominion Government of Canada. Several lambs have already been born, and the prospects seem good for the establishment of these plants.

Where forests are overstocked with game, breeding stock can be spared for use on other forests or for plants on lands outside the forests. Many requests for deer to restock areas in the eastern section of the United States are received. At present the supply of deer available for this purpose on the eastern forests is very limited, and attempts to use western deer for this purpose have not been very successful.

Plans are being developed, however, on the Pisgah Forest, in North Carolina, for trapping animals on the Federal game refuge there, which is becoming overstocked, for planting elsewhere. Requests for buffalo are also frequently received. A limited number of these animals can be furnished from the Wichita Forest in Oklahoma, but the principal source of supply is the National Bison Range in Montana, administered by the Bureau of Biological Survey.

Exact information regarding the number of game animals in a given territory is essential for good game management, particularly when the game uses the same range as domestic livestock. Without such knowledge, if the ranges are overgrazed, reductions can not be satisfactorily apportioned. It is equally important to have reliable means of determining the carrying capacity for game animals of each range unit. Regulation necessitates knowing both the number of animals on the area and the number for which feed is available. Careful studies of the feed habits of game and more satisfactory ways of taking a game census are required. Studies dealing with the vital statistics of game and their proper management are likewise necessary if use of the game resources is to be wisely correlated with other phases of forest conservation.

On several forests in New Mexico, Arizona, and California and in some places in the East deer have increased to the point of overpopulation. The acute situation that has resulted on the Kaibab Forest, in northern Arizona, has been repeatedly set forth in reports of previous years. Pronounced overstocking is now in evidence also on portions of the Gila Forest, in New Mexico, and the Coronado Forest, in Arizona. This necessitates knowledge both of the extent to which the herds should be reduced and of the best means of getting rid of the surplus. Relations with the State and local authorities are involved, and the problems presented can be met most successfully through cordial cooperation and careful joint planning. Steps have recently been taken to secure full cooperation between State game departments, the Bureau of Biological Survey, and the Forest Service.

On the Grand Canyon Game Preserve, in Arizona, supervised hunting is being used to bring the deer herd down to the carrying capacity of the range. Definite hunting areas have

been established and the number of deer to be removed has been determined. Hunters are required to stay at fixed camps supervised by a deputy game warden. The number and sex of animals allowed each hunter is specified. Adequate guide service is provided, and a close check is kept upon all animals removed and upon the distribution of hunters. Under this plan in the last three years more than 2,000 hunters have taken about 2,000 deer.

On the Teton National Forest, in western Wyoming, certain range reserved but not at present fully utilized for winter elk range has been applied for by sheepmen. Urgent representations have been made both for and against the change. The question raised by the application makes necessary a careful determination of the needs of domestic livestock in the region, the needs of game animals and of recreationists, and the requirements of other related uses. These needs must then be given priorities according to their relative public importance. In solving this problem, as in many others, an essential starting point is full recognition of the practical and scientific sides of game-resource administration, as well as of the need for protection.

WATER POWER

On June 30, 1929, 259 water-power permits or easements issued by the Department of Agriculture were outstanding. This is 13 less than a year earlier. The decrease is due to abandonment of proposed power projects or of existing power structures, and to relinquishment of permits or easements in order to get rights under the provisions of the Federal water power act. Of the outstanding 259 permits or easements, 175 require the payment of an annual rental; the rest are free. For 59 rental permits for power projects the estimated average output at minimum discharge is 516,286 horsepower, and for the 62 free permits for power projects 26,089 horsepower. The permits or easements involving transmission lines only included 116 rental permits, with a transmission length of 923.46 miles within the forest boundaries. Twenty-two transmission permits without rental charge cover a length of 155.40 miles within the forest boundaries.

At the close of the fiscal year the Forest Service, at the request of the Federal Power Commission, was supervising operations of 295 permittees or

licensees, an increase of 38 cases during the year. The commission requested the Forest Service to make field investigations and reports in 61 cases of application for permit or license. The Forest Service reported on 63 cases and also made several valuations and appraisals. Of the 100 projects for which application was received by the Federal Power Commission during the year, 55 involved the use of national-forest land. The district foresters issued 14 permits for projects of 40 horsepower or less and for periods not exceeding 10 years.

An expedition known as the Alaskan Aerial Survey Detachment, representing cooperation between the Navy, the Department of the Interior, and the Department of Agriculture, is now engaged in completing the aerial survey of southeastern Alaska, partially made in 1926. The purpose of this survey is to obtain material for the compilation of maps of areas whose topography is so rugged as to make mapping by regular ground methods very difficult. The benefits derived from the 1926 work have been very great, and already this season a hitherto unknown power site of more than 20,000 horsepower has been discovered in the Tongass National Forest. The potential value of this one discovery more than offsets the entire cost of the survey.

Because of a decision by the Attorney General that this department is without authority to transfer water-power permits, present procedure requires that when the rights to or interests in structures on land under a power permit from the Department of Agriculture are sold or transferred by the permittee or by operation of law, the successor in interest must apply to the Federal Power Commis-

sion for a permit under the provisions of the Federal water power act. During the year several applications for transfers involving change in ownership as well as a change in name were made to the Forest Service. Upon being informed that this department could not make the transfers, the permittees or the successors in interest questioned the Attorney General's ruling on several grounds. As large amounts of money are involved in these cases and as other similar cases will arise, it was decided to request the Attorney General to review his earlier decision. The results of this review are expected soon.

ROADS

Tables 20 to 24 show the appropriations, expenditures, balances, and progress made in connection with forest roads. Both expenditures and accomplishments were decidedly greater than in the preceding year, when the Bureau of the Budget limited the total expenditure to \$7,500,000. The work is now governed by what amounts to a mandatory law that the money available for obligation shall be promptly obligated and that the work shall be pushed to the extent that the authorizations and appropriations thereunder make possible. As a result the difference between the total authorizations to obligate and the total appropriations under them is less than at any time since the passage of the Federal highway act. From present indications, the difference for the forest road development fund will practically disappear during the next year. The same is true of the forest highway fund to the extent that is possible with work handled under contracts normally running into two fiscal years.

TABLE 20.—Classification of mileage in forest road and trail systems and expenditures required to complete system to satisfactory standard

Class	Total	Satisfac- tory standard	Unsatis- factory standard	Non- existing	Expendi- tures re- quired to complete
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Dollars</i>
Forest highways.....	15,332	6,003	8,142	1,187	152,648,007
Forest development roads.....	45,799	19,279	11,634	14,886	56,394,626
Rails.....	131,087	90,383	10,291	30,413	5,286,020
Total.....					214,328,653

TABLE 21.—Construction, improvement and maintenance of roads and trails from forest road appropriations and other Federal and cooperative funds by States, June 30, 1929

State	Fiscal year 1929				Total to June 30, 1929		Expenditure to June 30, 1929		
	Constructed		Maintained		Constructed		Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails	Roads	Trails			
	Miles	Miles	Miles	Miles	Miles	Miles	Dollars	Dollars	Dollars
Alabama	76.5		111.5		102.5		87,939.39	2,275.00	90,214.39
Alaska	20.4	29.7	200.6	103.0	217.8	356.5	4,192,718.13	319,803.74	4,512,521.87
Arizona	358.7	81.0	1,085.0	897.5	1,341.4	1,583.0	4,808,477.08	860,561.64	5,669,038.72
Arkansas	31.2	20.0	208.0	167.0	410.4	518.9	936,049.55	26,247.73	962,297.28
California	487.1	482.9	3,487.9	6,495.7	2,030.2	3,099.6	12,095,574.29	4,425,782.54	16,521,356.83
Colorado	108.6	247.7	700.6	8,071.3	1,272.8	4,352.3	5,949,104.73	864,932.23	6,814,036.96
Florida	81.0		62.9		210.9		338,728.33	136,411.18	475,139.51
Georgia	6.5	11.5	62.1	182.2	54.6	170.6	379,690.58	38,337.99	418,028.57
Idaho	110.3	1,732.5	1,805.7	11,151.3	1,886.6	10,580.4	12,122,527.65	1,594,898.62	13,717,426.27
Illinois							414.33		414.33
Kansas					3.4		2,111.51		2,111.51
Kentucky							808.72		808.72
Maine			5.3	40.8	5.3	40.8	37,602.87		37,602.87
Maryland							70.05		70.05
Michigan			280.0		31.2		71,438.61	393.45	71,832.06
Minnesota	22.1	27.1	112.2	329.6	352.6	139.1	689,044.75	250,408.12	939,452.87
Montana	52.7	1,613.0	1,195.0	8,584.0	940.4	5,416.3	7,367,611.68	612,084.59	7,979,696.27
Nebraska	.6		22.6		46.9		74,300.76	990.80	75,291.56
Nevada	1.9	53.5	217.7	382.8	429.5	831.0	1,232,859.94	147,881.06	1,380,741.00
New Hampshire	2.0	61.5	39.0	377.0	42.6	438.0	268,508.16	18,474.83	286,982.99
New Jersey							217.71		217.71
New Mexico	122.5	86.0	644.3	1,469.5	777.9	1,444.3	3,632,751.68	308,453.93	3,941,205.61
New York							81.32		81.32
North Carolina	20.0	1.0	180.2	596.2	196.5	604.5	636,543.44	60,612.35	697,155.79
North Dakota					1.0		57.75		57.75
Oklahoma			34.1		24.7	16.5	50,977.74	12,362.16	63,339.90
Oregon	324.6	1,418.1	4,229.8	8,699.6	2,798.6	6,110.8	11,299,205.67	5,649,226.71	16,948,432.38
Pennsylvania	1.3		69.0		47.0		74,072.89	1,155.00	75,227.89
Porto Rico				36.0	4.6	36.3	17,239.41	550.00	17,789.41
South Carolina		14.2	16.9	4.0	16.3	18.2	97,354.53	15,659.81	113,014.34
South Dakota	11.4		151.8	14.8	279.6	61.7	718,977.48	199,121.37	918,098.85
Tennessee	4.0	19.0	57.7	514.1	93.1	476.6	346,360.06	134,002.88	480,362.94
Utah	36.2	151.8	625.2	1,228.8	1,026.4	3,304.5	3,086,924.06	763,880.77	3,850,804.83
Virginia	7.0	2.0	148.4	529.5	110.4	729.6	490,516.02	37,581.21	528,097.23
Washington	81.5	1,304.4	1,043.8	7,516.3	951.6	4,459.9	7,262,423.06	1,541,403.84	8,803,826.90
West Virginia	9.5	60.7	87.8	241.7	59.0	325.7	156,366.28	5,299.98	161,666.26
Wyoming	35.1	35.5	536.7	4,641.9	964.7	2,040.0	3,867,968.53	376,252.06	4,244,220.59
Total	2,012.7	7,453.1	17,421.8	62,274.6	16,730.5	47,175.1	82,393,618.79	18,405,045.59	100,798,664.38

TABLE 22.—Distribution among the States of the apportionments for the fiscal year 1930

State	10 per cent fund	Forest high-way fund	Forest road development fund	Total
	Dollars	Dollars	Dollars	Dollars
Alabama	75.57	3,463.00	11,727.00	15,265.57
Alaska	8,251.56	460,509.00	18,783.00	487,543.56
Arizona	37,059.42	282,288.00	148,487.00	467,834.42
Arkansas	7,563.35	41,917.00	69,471.00	118,951.35
California	142,645.49	677,175.00	481,881.00	1,301,701.49
Colorado	49,886.12	323,044.00	151,776.00	529,706.12
Florida	3,155.90	11,436.00	16,209.00	30,800.90
Georgia	1,340.55	7,605.00	23,574.00	32,519.55
Idaho	62,771.25	491,648.00	623,205.00	1,177,624.25
Illinois		391.00		391.00
Maine	566.44	1,365.00	2,399.00	4,330.44
Michigan	674.15	3,581.00	1,331.00	5,586.15
Minnesota	2,850.03	29,268.00	20,751.00	52,869.03
Montana	26,387.56	397,999.00	253,177.00	677,563.56
Nebraska	958.48	4,659.00	1,013.00	6,630.48

TABLE 22.—*Distribution among the States of the apportionments for the fiscal year 1930—Continued*

State	10 per cent fund	Forest high-way fund	Forest road development fund	Total
	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Nevada.....	9,252.31	94,463.00	14,807.00	118,522.31
New Hampshire.....	7,812.84	21,399.00	10,504.00	39,715.84
New Mexico.....	13,950.75	202,401.00	104,522.00	320,873.75
North Carolina.....	3,061.92	12,782.00	30,332.00	46,175.92
Oklahoma.....	456.89	1,982.00	225.00	2,661.89
Oregon.....	106,007.34	632,638.00	477,603.00	1,216,248.34
Pennsylvania.....	404.89	7,403.00	17,346.00	25,153.89
Porto Rico.....	24.99	533.00	135.00	692.99
South Carolina.....	506.75	1,474.00	4,605.00	6,585.75
South Dakota.....	17,195.31	39,481.00	14,219.00	70,895.31
Tennessee.....	1,192.31	11,853.00	34,653.00	47,698.31
Utah.....	20,514.82	166,445.00	60,664.00	247,623.82
Virginia.....	3,695.31	14,997.00	38,377.00	57,069.31
Washington.....	67,111.71	332,614.00	256,187.00	655,912.71
West Virginia.....	698.12	6,673.00	25,074.00	32,445.12
Wyoming.....	29,783.76	211,512.00	86,965.00	328,260.76
Total.....	625,855.89	4,500,000.00	3,000,000.00	8,125,855.89

TABLE 23.—*Distribution among the States of the total apportionments including the fiscal year 1930*

State	10 per cent fund	Section 8 fund	Federal forest road construction fund	Forest high-way fund	Forest road development fund	Total
	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alabama.....	808.01	15,456.04	1,922.31	27,811.00	55,935.00	101,932.36
Alaska.....	150,404.03	470,080.01	193,549.95	4,029,825.00	199,519.00	5,043,377.99
Arizona.....	569,356.48	679,628.89	501,984.55	2,436,536.00	1,198,157.00	5,385,662.92
Arkansas.....	99,327.11	174,939.40	128,773.38	303,547.00	408,218.00	1,114,804.89
California.....	1,354,080.86	1,462,824.02	1,206,815.23	5,921,874.00	3,563,348.00	13,508,942.11
Colorado.....	642,823.07	759,622.61	777,307.26	2,909,809.00	1,446,028.00	6,535,589.94
Florida.....	33,893.23	119,528.14	21,534.94	99,297.00	121,011.00	395,264.31
Georgia.....	9,747.41	52,325.41	134,387.16	71,733.00	142,436.00	410,628.98
Idaho.....	845,221.45	1,197,509.73	1,367,402.82	4,418,880.00	5,428,515.00	13,257,529.00
Illinois.....				1,556.00	396.00	1,952.00
Iowa.....	1,867.27					1,867.27
Kentucky.....	722.72				86.00	808.72
Maine.....	2,769.53	32.41	3,738.77	11,232.00	21,884.00	39,656.71
Maryland.....	70.05					70.05
Michigan.....	2,690.73	115.63	3,000.00	21,457.00	57,118.00	84,381.36
Minnesota.....	34,362.65	8,215.41	108,352.03	254,853.00	326,118.00	731,901.09
Montana.....	540,998.07	755,919.22	731,497.39	3,518,250.00	2,800,271.00	8,346,935.68
Nebraska.....	17,613.92	18.98		42,801.00	27,851.00	88,284.90
Nevada.....	157,380.07	194,918.55	82,265.33	838,928.00	117,885.00	1,391,376.95
New Hampshire.....	36,179.29	341.66	10,941.30	148,061.00	125,176.00	320,699.25
New Jersey.....	118.99				83.00	201.99
New Mexico.....	325,158.90	430,170.33	509,215.36	1,833,496.00	959,322.00	4,057,362.59
New York.....	4.00				50.00	54.00
North Carolina.....	31,784.15	84,801.99	176,890.28	115,306.00	255,166.00	663,948.42
North Dakota.....	45.75	7.00				52.75
Oregon.....	8,972.44	65.49	2,775.17	20,350.00	22,520.00	54,683.10
Pennsylvania.....	909,295.89	1,430,677.15	1,077,552.29	5,061,631.00	4,042,461.00	12,521,617.33
Porto Rico.....	1,871.83	24.04	21.42	30,012.00	69,787.00	101,716.29
South Carolina.....	28.69	7.00	3,343.09	5,410.00	11,948.00	20,736.78
South Dakota.....	2,230.38	402.10	48,028.61	12,229.00	43,742.00	106,632.09
South Dakota.....	153,690.86	83,674.78	79,341.53	317,275.00	185,236.00	819,218.17
Tennessee.....	17,177.24	103,433.37	28,092.79	90,151.00	175,282.00	414,136.40
Utah.....	361,049.98	445,632.53	464,562.35	1,495,147.00	571,421.00	3,337,812.86
Virginia.....	38,816.31	58,390.16	71,902.26	126,964.00	245,342.00	541,414.73
Washington.....	547,860.46	939,348.21	712,201.40	2,872,412.00	2,810,816.00	7,882,638.07
West Virginia.....	4,802.58	12,830.41	5,049.24	40,811.00	126,515.00	190,008.23
Wyoming.....	379,786.69	471,800.49	547,551.79	1,922,356.00	940,387.00	4,261,881.97
Undistributed.....		47,258.84				47,258.84
Total.....	7,283,011.09	10,000,000.00	9,000,000.00	39,000,000.00	26,500,000.00	91,783,011.09

TABLE 24.—Condition of forest road funds on June 30, 1929

Fund	Appropriations	Expenditures	Unexpended balance
	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
10 per cent.....	6,656,998.28	6,293,113.29	363,884.99
Section 8.....	10,000,000.00	9,865,984.86	134,015.14
Federal forest road construction.....	9,000,000.00	9,000,000.00	-----
Forest highway.....	34,500,000.00	32,453,559.15	2,046,440.85
Forest road development.....	23,500,000.00	23,040,810.49	459,189.51
Total.....	83,656,998.28	80,653,467.79	3,003,530.49

The determination of a standard series of road signs has been pushed. Some changes and additions will be advisable as a result of further experience and as increased needs develop. The Forest Service standards are applicable to the forest roads on the forest-development system and on the county and community system. These standards are consistent with and modeled on the standards which have been adopted for the United States highways, and which the States are expected to approve for the State highways.

The service requirements on the forest-development roads that the Forest Service is constructing are small in nearly every case, so that a low-standard road adequately meets the needs. In matters of width, gradient, and alignment there are marked differences from the forest highways, constructed under the supervision of the Bureau of Public Roads. Equipment and construction methods required for the high-standard roads do not meet the needs for the low standard. During the past two years improvements in equipment and the use of equipment manufactured primarily for other purposes have made possible decided changes in the construction methods, and lowered costs. The new equipment does not yet exactly meet our needs, but improvements and redesign by the manufacturers are expected. The advantages and disadvantages of various types of equipment and methods were thoroughly demonstrated at a field meeting on the Santa Barbara Forest in April.

One of the most interesting developments has been the construction of motor ways in certain regions heavily covered with brush, of which mention was made earlier in this report. A tractor of from 60 to 75 horsepower attached to a heavy grader, and occasionally a road ripper, is the equipment used. While this method is

adapted to only a small percentage of the total national-forest area it is very successful where the conditions are suitable. A satisfactory means of transportation is secured for from \$100 to \$300 a mile.

The objective in the forest-development work is to provide the kind of road that will render the required service at the minimum cost for construction and maintenance. Decided progress toward this objective was made during the year. Also a new method has been worked out for determining the most advantageous and economical location, mileage, and standard of roads and trails and the number and location of smoke chasers. This method is apparently both feasible and very satisfactory, but it has not yet been given a thorough demonstration through working out the complete plans for several forests. It is expected that this will be done during the coming year.

Roads required for the protection and utilization of the forests are as essential to the public as those which are sections of the Federal-aid and the State and county road systems. It is very important that the construction of these forest-development roads be advanced as rapidly as possible, and in balance with the forest highways, so that the proposed development system will be completed along with the forest-highway system.

MAPS AND SURVEYS

During the year the Forest Service published for its administrative use 26 national-forest maps on the scale of one-fourth inch to the mile, 13 maps on the scale of one-half inch to the mile, and 2 maps on the scale of 1 inch to the mile. Six presidential-proclamation diagrams were issued in cooperation with the Department of State.

A triangulation net of third-order accuracy was extended over a portion

of the Datil National Forest, in New Mexico. This net gave sufficient control points from which to initiate grazing and timber-survey projects. Two topographic surveys on a field scale of 2 inches to the mile were made on the Klamath and Shasta National Forests. Two drainage surveys were made on the Nezperce National Forest, in Idaho, and the Wyoming National Forest, in Wyoming. Numerous smaller timber, grazing, and land-exchange areas were also topographically surveyed.

The aerial survey work on the Nezperce National Forest, which had to be abandoned in the fiscal year 1928, was resumed. Approximately 170 square miles of the northern part of the forest was photographed vertically. A mosaic map embracing 22 square miles of this area was made on a scale of 6 inches to the mile.

In connection with the acquisition of lands in the East, 817 miles of boundary lines were surveyed at a cost of about \$55 per linear mile.

The drafting organization compiled, revised, or traced 24 base maps of national forests. Nine atlas pages showing culture, drainage, and contours were prepared for western forests, while 72 atlas pages were drafted for the eastern forests. One thousand three hundred and sixty type maps and atlas pages were colored. One hundred and fifty graphs showing research data were compiled, besides numerous posters, range maps, status and ownership maps, organization charts, and naval-stores graphs.

Work in connection with the Mississippi flood-control reports was continued, and maps of a far more detailed character than those of the preceding year were prepared. The 6 major basins of the previous study were expanded into 80 or more sub-basins, necessitating further research and a far more definite treatment. Twenty-two separate maps and graphs were made for this project. A special report on forest conservation required 32 separate maps and graphs, of which 12 were drafted on a large scale for exhibit purposes.

The photographic laboratory made over 3,700 lantern slides and approximately 97,000 square feet of blue prints, Van Dyke, photostat, and solar bromide prints, besides mounting over 10,000 square feet of maps on cloth. Over 3,900 square feet of wet plates were sensitized and exposed. In addition 69,000 photographic prints were made, of which 760 were mounted.

Over 5,000 rolls of films were developed and about 3,800 square feet of photoview enlargements were made.

The General Land Office is able to handle all administrative needs for township surveys and resurveys. During the year 55 township surveys were initiated, and 101 were completed.

The Geological Survey surveyed approximately 3,400 square miles of national-forest land. This is less than 2 per cent of the total unmapped area.

RESEARCH

As the research activities of the Forest Service progress it becomes increasingly evident that to work out successfully the great forest problems of the country all the forms of research that are now being brought to bear on the problem need to be utilized on a larger scale and organized in a correlated, carefully directed, planwise attack. The problem is exceedingly complex. It calls for full knowledge of the location, quantity, and quality of our present forest supplies; of the methods of forest management necessary to grow forest supplies of different kinds under the most diverse conditions in widely separated regions; of the costs of growing timber; of the character of our present requirements for forest products, and their regional location; of the character and extent of such needs for the future; of the structure, composition, and properties of wood and the best methods of utilizing it industrially; and of almost innumerable kindred matters that in one way or another will have a part in determining the future of our forests.

Under the provisions of the McSweeney-McNary Act, a start is being made in such an expanded and correlated attack. As it takes shape it is becoming clear that in very large degree our research problems lend themselves to regional analysis.

When the first regional forest experiment stations were established, in 1921, the studies carried on dealt mainly with timber growing and forest-fire protection. It now appears that some of the forest investigations dealing with forest economics, range management, and forest products can be best handled under the same regional organization. There are, however, certain classes of problems dealing with the utilization of forest products which are nation-wide in scope and which require the facilities of a thoroughly equipped laboratory for their solution. Such problems can be

best handled by centralizing their study, as is being done at the Forest Products Laboratory, at Madison, Wis. As the investigative program develops, however, it is becoming evident with regard to an increasing proportion of the forest-research projects that they require to be handled jointly by the regional experiment stations and the Forest Products Laboratory, working in the closest cooperation.

To obtain the advantages of regional unification of research activities in silviculture and in forest products the separate office of forest products previously maintained under the district forester at San Francisco was last year made a part of the California Forest Experiment Station. The principle is being further expanded to include at this station and at the Great Basin, Lake States, and Southern Forest Experiment Stations research in erosion control, for which the 1930 agricultural appropriation act made special provision. The southern station is also making plans for a regional study of the financial aspects of forestry. The forest survey authorized by the McSweeney-McNary Act is being inaugurated regionally by the Pacific Northwest Forest Experiment Station. Closer cooperation between the Forest Products Laboratory and the various regional experiment stations is being brought about by the appointment of joint committees and by the detail of men from the regional stations to the laboratory when problems making this course advantageous are under investigation.

Thus research will go forward at the regional forest experiment stations not only in silviculture but also in forest economics, range management, and to some extent in forest products. The investigations in forest products at the stations will consist very largely of regional and local field studies.

The unification of regional research also provides better means of cooperating with other bureaus of the Department of Agriculture in the various lines of their work which are closely related to forestry problems. Last year two forest pathologists under the direction of the Bureau of Plant Industry were assigned to the Southern Forest Experiment Station, in addition to the men already assigned to forest experiment stations in other regions and to the Forest Products Laboratory. This year the Bureau of Entomology has assigned a man to work with the Pacific Northwest For-

est Experiment Station. Other entomologists are established at the north-eastern, at the Appalachian, and at the California stations. As a result of the increase in appropriations for forest wild-life investigations, the Bureau of Biological Survey will be able during the fiscal year 1930 to place two men at forest experiment stations, one of these to be assigned to the Appalachian and one to the Lake States station.

The funds made available for research activities under various appropriation items for the fiscal year 1929 are compared with the amounts for 1928 and for 1930 in Table 25. The 1928 funds were in part provided through allotments from general appropriations for Forest Service salaries and expenses.

TABLE 25.—*Appropriations for 1929 as compared with those in 1928 and 1930*

Class of research	Appropriations for fiscal year—		
	1928, directly appropriated and allotted ¹	1929, directly appropriated ²	1930, directly appropriated
Silvical investigations.....	\$353,080	\$377,407	\$413,000
Forest products investigations.....	503,420	542,596	585,000
Range investigations.....	49,755	52,680	67,000
Forest taxation study.....	48,665	63,640	65,000
Forest insurance study.....	-----	-----	10,000
Forest survey.....	-----	-----	40,000
Forest economic studies.....	-----	-----	25,000
Erosion studies.....	-----	-----	30,000

¹ Includes following allotments from other appropriations: Silvical investigations, \$16,080; forest products investigations, \$3,420; and range investigations, \$4,875.

² Includes Welch Act increases.

FOREST-ECONOMICS INVESTIGATIONS

In the study of forest taxation, field work was concluded in the Pacific Northwest and a large part of the data compiled. The same is true of a preliminary taxation study conducted in New Hampshire. Advance tables presenting such of the results as could be prepared soon enough were furnished the State forest and tax authorities in Oregon and New Hampshire, respectively, for the legislative sessions of those States. They proved especially timely in Oregon, where forest-tax legislation was in the process of framing and enactment. Tables dealing in detail with conditions in Grays Harbor

County, Wash., were furnished the Western Forestry and Conservation Association for use in connection with a Grays Harbor regional economic and forestry investigation. An office study of the methods by which forest lands are taxed in Europe was initiated.

The policy of making public progress reports was continued, and two were issued. One, which has been in great demand, was a digest of the State forest-tax laws in effect on January 1, 1929, together with a brief historical summary of tax legislation and a table showing the more important provisions of State forest laws.

Statistics of lumber production in 1928 were gathered in 12 Western States, in cooperation with the Bureau of the Census. The Forest Service handles about one-ninth of the schedules, but the returns include 44 per cent of the total lumber cut. In the same canvass questionnaires were obtained showing lumber distribution in 1928. This project was expanded to show, not only the quantities shipped from each State to every other State, but also the shipments to the several Canadian Provinces and to the principal countries of other continents. The Canadian Bureau of Statistics is cooperating by gathering for the first time statistics showing the distribution of shipments from the United States within the Dominion, and the source and destination of its lumber exports. It is proposed to combine these results to give a fairly comprehensive picture of the quantities and sources of lumber consumed in all parts of North America north of Mexico.

Data on stumpage and log prices, principally from 1900 to 1928, have been accumulated which lend themselves to compilation by species and regions, and upon other bases of classification. They should prove increasingly valuable in connection with forest economic studies. The figures for 1927, as for 1925 and 1926, disclose a tendency to break the long-continued upward trend of prices.

A several years' study of the economic relationship of forests to the whole economic system of a region, and of the results of the destruction of this resource, produced a publication on the economic aspects of forest destruction in northern Michigan. This is believed to be the most comprehensive and instructive study undertaken in its field. Cooperation was given to the Wisconsin Agricultural Experiment Station in a study of the use and taxa-

tion of land in Lincoln County of that State, which resulted in a publication setting forth the problem of tax delinquency, its relation to land-use problems, and constructive suggestions for meeting the northern Wisconsin situation. Through addresses and published articles contributions were made to the development of thought on the increasingly important subjects of the relation of forestry to farm relief, the relation of the forests of the Pacific Northwest to New England forestry, and problems in determining the economic feasibility of land use for forest purposes.

The extension of private forestry practice, the development of sound public and private programs of land use, and the practical application of the findings in the several fields of forest research hinge largely upon economic conditions and forces. Investigations in the field of economics, however, have lagged far behind the forestry studies in other fields. More definite recognition was given to this highly important field by the appropriation for the fiscal year 1930. The most important project inaugurated is a forest survey to secure an accurate, detailed, and comprehensive appraisal of the Nation's present and future requirements for forest products, the present and potential forest growth, the present situation as to volumes and quality of timber and as to areas and condition of forest lands, and the economic influences and relationships involved. This is essentially a land-use study, designed to lay a broad foundation of economic facts as a basis for productive forest-land use. As a first step the Forest Service, in cooperation with the Bureau of the Census and the National Lumber Manufacturers' Association, has initiated a statistical canvass of the wood requirements of the secondary wood-using industries, classified by kind of industry, State, species, and the form in which the wood is needed. This when related to the somewhat similar studies made by the Forest Service in the years 1909-1913, and to some future canvasses, will give reliable indications of trends in wood requirements. Two other important economic studies already initiated for the fiscal year 1930 are an investigation of the financial aspects of private forestry practice and a study of forest insurance. Both will supply information which should greatly stimulate the private practice of forestry and the development of wise land use in the United States.

RESEARCH IN FOREST MANAGEMENT AND PROTECTION

The need for early solution of the forest-management problems of the major timbered regions of the United States is urgent. Many timberland owners are considering the possibilities of forestry. Management of the national forests also presents many problems that demand silvical research. In particular the national forests that are being built up in the East through land purchases call for research. Most of the purchased lands have been lumbered and badly damaged by fire. They are being acquired partly to protect watersheds, partly to grow timber, partly to demonstrate methods of large-scale timber growing. They must be restored to good condition through the right silvicultural practices, so that their full potential timber-growing and protective capacity may be developed and maintained. Just as successful agriculture, successful forest culture demands the application of extensive scientific research that must be systematically built up.

To meet the need for research in each of the major forest regions of the United States a series of forest experiment stations is being developed. So far six have been established in the East and four in the West. All of the stations lack resources for covering fully their respective problems. Increased appropriations for the fiscal year 1930 provide for enlarging the work in the Lake States and for strengthening somewhat the naval-stores work in the South.

In formulating their research programs most of the forest experiment stations are aided by advisory councils, appointed by the Secretary of Agriculture, which bring forward the problems that most need investigation in each region. Councils appointed last year for the Central States and Allegheny experiment stations brought the total number to eight.

FOREST-FIRE STUDIES

A number of the forest experiment stations are conducting forest-fire research. In northern California the relation between fire and the different types of ground cover—grass, chaparral, brush, and the various timber types—was studied, and data were obtained upon the risk of fires starting, the quantity of fuel on the ground, the ease of controlling fires, and the rate at which fires spread. An analysis of the records of over 10,000 fires fur-

nished valuable conclusions upon which to base more efficient protection by establishing the length of the average fire season for each cover type, the preponderance of incendiarism in the chaparral and brush types, and the relative difficulty of protecting each type. On the basis of the rate of spread and the difficulty of control of fires in the different cover types the ratio between those easiest and those most difficult to protect was placed at 1 to 50. These facts afford a basis for placing fire guards, for determining the size of suppression crews, for the development of roads and trails, and for combating incendiarism. The study showed also that in the most valuable timber type, the western yellow pine fires have covered annually more than 1 per cent of the entire area. At this rate, in 90 years, the fires will cover an area equal to that of the whole type.

Study by the Southern Forest Experiment Station of some severe fire that occurred in the spring of 1927 on certain cut-over longleaf and slash pine areas in southern Georgia, following two months of deficient precipitation, afforded data on the relative destruction under varying surface conditions and in stands of varying age. Areas which had been burned annually had no living pine reproduction upon them. Another study made upon a loblolly pine stand in Louisiana disclosed that the growth in three years after a fire that occurred in 1924 was only 72 per cent of that in the three years before the fire, or a loss of 325 board feet per acre for the three years. With the vast area of pine land in the South that is burned each year, the aggregate loss from impaired growth rate to say nothing of the losses in the form of young growth killed and mature timber destroyed, is tremendous.

An analysis by the Lake States Forest Experiment Station of Minnesota and Michigan forest-fire statistics gave valuable information upon the seasonal occurrence, concentration and causes of forest fires in those States, and a study of the effect of weather conditions and forest cover on fire hazard in that region was initiated.

The Northwestern Forest Experiment Station studied methods of felling snags, including the method mentioned on p. 27, in which an electric machine is used to bore holes for blasting the snags down with powder. A 110-volt dynamo set up on a truck furnished the power. With this equipment it

was found that snags could be felled cheaply and quickly, and a fairly good control of the direction of fall was obtained.

This method is applicable only in country accessible to a truck. Attention is now being given to devising a portable boring machine and a light gas-engine dynamo that can be packed into the more inaccessible mountain regions. The blasting method of snag falling has already been used with good results in fighting fire.

At the Northern Rocky Mountain Forest Experiment Station fire data were analyzed that have been collected since 1922, and conclusions were published concerning the elements of danger. Six degrees of duff inflammability have been distinguished, the effect of each of the weather elements has been determined, and the weather forecasts can now be translated into predictions of forest inflammability. As an adjunct of this work a high degree of cooperation between the Weather Bureau and the Forest Service has been effected. Through the results of the study and cooperation with the Weather Bureau the efficiency of forest-fire protection by State, Federal, and private agencies has been decidedly improved.

NAVAL STORES

The Florida branch of the Southern Forest Experiment Station continued its study of naval-stores extraction. On the experimental area at Starke tests begun in 1923 were completed and the data largely analyzed. Several new tests upon a total of 4,170 trees were started. In the height-of-streak tests quarter-inch chipping of slash pine showed for the 5-year period a 6 per cent greater yield than half inch, and a 7 per cent greater yield than $\frac{3}{4}$ -inch chipping. The gain came entirely during the last two years. In longleaf pine, where openness of the stand created conflicting conditions, half-inch chipping gave the highest yield, and quarter inch the lowest. Narrow chipping always results in a pace that can be worked from two to five years longer than is the case with wide chipping. Depth-of-chipping tests upon both slash and longleaf pines gave the best results with a half-inch depth, although for the first two or three years deep chipping produced heavier yields. The shallower chipping is superior mainly because it permits a more healthy condition of the trees. Width-of-face tests have

been carried on for three years, and indicate increased gum yields with increases in the width of faces, but not in the same ratio.

SOIL EROSION

There is a growing interest in soil conservation. In many parts of the United States serious losses of soil fertility have occurred, a great area of valuable farm land has been ruined, and streams and reservoirs have been silted up. Much of the tremendous burden of silt carried by the Mississippi River comes from forest lands or lands which should never have been placed under the plow. Congress has this year given money for a study of erosion and part of it will be used by the Forest Service to study methods of erosion control in the loess-soil region along the lower Mississippi, where the damage has been particularly heavy, and in California, where erosion from burned chaparral and forest areas has caused the loss of many farms, has silted reservoirs, and has destroyed much other property. The purpose of the studies will be to determine the part that forests play in the control of erosion under the local conditions.

Data upon flood conditions in the Mississippi River basin collected by the four eastern forest experiment stations led to the conclusion that the present forests of the Mississippi watershed retain water to an amount equivalent to a reduction of more than 1 foot in the flood crest, and that by proper protection, care, and management the amount might be raised to more than $4\frac{1}{2}$ feet.

Recent and as yet uncompleted investigations by the California Forest Experiment Station indicate that the surface run-off from forest soils from which the litter has been removed is from 10 to 30 times greater than from soils with a complete and undisturbed mantle of forest litter. The reason for this is simple—that when muddy water percolates into the ground the fine material carried in suspension is deposited close to the surface, where the particles clog up the pores in the soil. Thus the ground is made impervious. A forest cover breaks the force of the rain and keeps the water clear, while any pore-clogging material that may be picked up is strained out by the surface litter, so that when the water reaches the soil it is absorbed easily and rapidly. The California studies show that in comparison with the function performed by the forest litter

in maintaining the percolation capacity of the soil, its spongelike function as an absorbent of water, commonly regarded as one of its major protective functions, is insignificant.

In a laboratory experiment, after clear water had been run for 10 days through four tubes of soil, muddy water was substituted in two of them. In four hours their discharge dropped from 1,000 cubic centimeters an hour to 500, and after 10 days was down to 90 cubic centimeters. Meanwhile the discharge from the other two tubes, that were receiving clear water, remained constant. Muddy water was then turned into them also, with practically the same result that the first two tubes had given. It has been known in southern California for many years that muddy water may not be spread upon the gravelly débris at the mouths of the canyons if the water is to be stored in the underground artesian basin. Where muddy water has been so distributed the interstices in the surface gravel beds are effectively sealed and the result is as though the gravel were covered with an impervious coating.

This sealing effect of muddy water on bare soils accounts in large measure for the great differences that exist between run-off from a forested area and from a barren or denuded one. From the latter the discharge, with even a moderate rainfall, is likely to take the form of a flash flood; on the former most of the water is normally absorbed into the lower soil levels. The difference in erosive effect is of course enormous.

In the central-hardwood territory, extending from Ohio to Iowa and south to and including Tennessee, served by the Central States Forest Experiment Station, clearing of the land for agriculture has been carried beyond the point justified by the topography and the demand for farm products. Many thousands of acres of improved farm land in the hilly portions have already been abandoned, and many more probably will be in the near future. The remaining forest areas have been greatly damaged by fire, cutting, and grazing. The first meeting of the experiment station's research council indicated that the loss of valuable soil throughout the region as the result of widespread erosion demanded immediate steps for control. The station has therefore undertaken an examination of the eroded areas as the initial step in a plan for reforestation.

TIMBER-GROWING STUDIES

The Northeastern Forest Experiment Station is studying the silvicultural practices necessary to assure prompt and full restocking of pulpwood species upon spruce sites. Conditions have been found generally to be favorable for the continuous production of pulpwood crops. The study indicates that for the successful regeneration of spruce lands, nearly total dependence must be placed upon advanced growth. Spruce reproduction is normally abundant. The present practice of clear-cutting the spruce from areas of mixed spruce and hardwoods results in a preponderance of hardwoods. Investigations upon areas recently logged that have a residue of large worthless hardwoods indicate that girdling of the trees to release the spruce, followed by weeding to remove the young hardwood trees that have sprung up, will prove profitable.

The need for silvicultural research relating to the bottom-land hardwoods of the lower Mississippi Valley was brought out forcibly by a survey made last year through cooperation with the State forester of Louisiana, which disclosed that the hardwood forest lands of that region are in a far more serious condition than had been recognized. Instead of a large reservoir of old-growth timber, comparatively little of the old timber is left. Estimates indicate that relatively few lumber plants have sufficient timber to continue cutting more than 5 or 10 years. Some of the operators are asking for information as to the silvicultural measures that would put these hardwood lands in the best shape for regrowth, and as to the growth rate that could be looked for.

The existence of many plantations established during the past century in the central hardwoods region, particularly in the Prairie States where the original timber stands were scant, led to a study to determine the success or failure of different species and their yields which are being obtained. This project is now in its second year. The effects of grazing both upon the naturally forested areas and upon plantations will also be studied.

In the northern Rocky Mountain region many private owners have long wished to know the yields that might be expected at various rotations, in order to decide whether private forestry would prove advisable. The Northern Rocky Mountain Forest Ex-

periment Station has now determined that if western white pine land is well stocked with trees as the result of good seeding and fire protection, yields of from 30,000 to 40,000 board feet per acre can be obtained in 100 years on the fair sites, and from 50,000 to 80,000 at the same age on the best sites. The growth rates indicated in these fully stocked stands are sufficiently great to indicate strongly that private forestry will pay in this region.

FOREST PRODUCTS INVESTIGATIONS

The principal aim of forest-products research is to make forests and forest land of greater service. Forests serve human needs along varied lines, but in large degree their perpetuation depends upon the extent to which trees can be converted into useful commodities and the use of land to grow trees can be made profitable.

Better utilization means an enlargement of the merchantable yields per acre per year. It means not only the marketing of material now wasted in lumbering but also the marketing of species hitherto considered inferior or worthless. It involves the discovery and development of new uses for wood and wood products in the greatest possible variety. To find an effective and sufficient outlet, through industrial requirements, for what our vast forest-land area can be made to grow is just as important to our national economy as it is that industrial requirements be adequately met. The correlation of public requirements for forest material with the capacity of available forest lands to produce such material involves a twofold adjustment—of demand to supply, and of supply to demand. To promote this adjustment is the objective of the varied research projects described in the next few pages.

STRUCTURES, COMPOSITION, AND PROPERTIES OF THE MATERIAL

Wood is both a highly complex and widely variable material. Cellulose, lignin, pentosans, and extractives are combined in variable quantities and arranged in a complicated and variable microscopic structure. The composition and the structure vary not only between different species but also within a species and within a single tree. The final composition and structure give wood all its many but varying valuable properties.

Factors of environment such as spacing, soil, and light cause many of the variations. These environmental factors are to a considerable extent subject to control. The work of the Forest Products Laboratory is becoming increasingly interrelated with that of the forest experiment stations in determining the effect of environmental growth conditions on certain qualities and properties. During the year the previous conclusions in regard to the effect of spacing on the density and strength of hardwoods were confirmed by a study of Appalachian hickory. Where the rate of growth was maintained by proper spacing of the trees the hickory wood from this section equaled the preferred hickory from farther south. Investigations were started on the effect of growth conditions on the pulping qualities of southern pines, and on the density and strength of second-growth loblolly pine in Virginia. It is planned to extend this type of work to include the intermediate factors of structure and composition.

In the field of structure the previous discovery of an outer layer of the cell wall composed of fibrils running at approximately right angles to the cell axis was extended by the examination of a large number of species, in all of which this type of cell structure was found. A smaller structural unit of which the fibrils are built up was also discovered, and named from its shape the "fusiform body." It was found that the ease of separating the fibrils in wood-pulp fibers gives a direct index of the character of the chemical and mechanical treatment used in pulping. This is expected to lead to a new technic for judging the quality of pulps and for controlling pulping processes. A technic was also developed for measuring the spiral angle of the fibrils of the inside layers, which preliminary measurements have shown to be related to the amount of longitudinal shrinkage.

Crude cellulose, which is the main constituent of wood, is different from the pure cellulose of cotton, and is of particularly complex chemical composition. Most of the cellulose research at the laboratory has been devoted to the hemicellulose (or cellulose impurities) that in wood are closely combined with the pure cellulose. The hemicelluloses, the main source of the sugars obtained from wood by hydrolysis, must be largely removed from wood cellulose before it is suitable for

use in the manufacture of such material as rayon. In cooperation with a committee of the cellulose division of the American Chemical Society a standard method was developed and recommended for the determination of alpha cellulose (the pure cellulose). It was also found that as good paper can be made from the crude wood cellulose as is made from commercial pulps, which are more nearly pure cellulose. This means that if pulping processes can be developed to retain the entire crude cellulose, pulp yields can be greatly increased without impairment of the properties of the final paper.

In the field of extractives two species have been studied extensively. In redwood the substance responsible for the red color was isolated and found to resemble the natural dyes brasilin and haematoxylin. It was also found that in drying redwood the extractives move toward the outside of the board and deposit just under the surface. Their effect on the strength properties of redwood, previously suspected, was confirmed. In western red cedar a complex organic acid was isolated that is thought to be responsible for the occasional corrosive action of the wood on metal. The study of extractives bears directly on the practical utility of wood.

Further progress was made in finding out how to improve the production of turpentine and rosin, particularly from the second-growth longleaf and slash pines of the South. Field demonstrations and other educational work were conducted to introduce the improved methods, which produced an increase of over 50 per cent in the average of recent yields in Florida. A study to determine the characteristics of high-yielding trees demonstrated that externally promising trees may produce so little oleoresin as to become a severe drain upon the returns from associated profitable trees. As in the rubber industry, the ability to select high yielders will be of primary importance. The whole field of naval stores research has a vital relationship to southern forestry.

Every wood has 30 or more properties relating directly to the requirements of use, such as bending and compressive strength, hardness, toughness, resistance to splitting, a certain degree of resistance to decay and staining, nail-holding power, and heat-insulating capacity—all varying widely even in the wood from one tree. How to segregate the material

to insure uniformity and better values, and how to modify the properties by methods of treatment, are matters requiring a basic knowledge of the properties themselves and of their variability. Much of the laboratory work is in this field. During the year a publication based upon half a million tests was completed, which presents the main mechanical properties of 164 species in form and language adapted for the practical use of wood users, distributors, and producers. Coincidentally studies were continued to determine more exactly the magnitude and causes of variability of properties. The results with redwood established among other things, a definite distinction between the properties of virgin and of second-growth material. Since for all species increasingly second-growth must be the source of supply its properties should be comprehensively studied.

A publication was completed on the nail-holding properties of various species, and studies were continued of the relative holding power of wood of different kinds, at different stages of dryness, and with nails of different sizes and designs.

A scientific study of the torsional or twisting strength of wood members used in aircraft parts was completed in cooperation with the Navy Department. Owing to the impossibility of calculating the torsional moment of many of the sections tested, a new method was devised which resulted in a body of torsional-moment data never before obtained, applicable to members made not only of wood but of any other material.

A manuscript prepared for publication on the properties and uses of western hemlock is intended as the first of a series to bring little-used species of wood into better standing through proper correlation of their properties with use requirements.

HARVESTING THE MATERIAL

Most lumbering operations are carried on without the operator knowing definitely the qualities and sizes of logs that yield a profit. To know with any certainty where to draw the line requires dependable data on logging costs and mill returns. Studies to obtain these data are being actively prosecuted in cooperation with representative groups of timberland owners and operators. Work on typical operations in the Lake States hardwoods and the Arkansas shortleaf-pine region

has been concluded, and the results have influenced the plans of both large and small timberland owners toward sustained-yield operations. For Appalachian hardwoods and the pine region of Oregon the field work was completed during the year, and the data are undergoing analysis. Field studies are under way in the loblolly-shortleaf mills of the South, in the California pine region, and in the Douglas fir region of the Northwest, with particular emphasis on determining the quantity and quality of waste material left on the ground under current logging methods. A closely allied study concerns forest waste through the inefficient operation of small and portable sawmills.

Converting the waste of logging and milling operations to some profitable use is another way to encourage private forestry. Production studies which have been completed on four types of dimension stock operations in the Lake States indicate that with good equipment and careful management industrial cuttings can be profitably manufactured from the poorer and smaller logs that are necessarily a part of any harvesting, and from the edgings and slabs in the sawmill.

SELECTION AND PREPARATION OF MATERIAL

To meet industrial demands for wood of known, uniform properties more effective methods of grading and selection are needed. Among laboratory projects looking to this end is a study, undertaken two years ago, to determine and classify the characteristic defects in lumber from different species and different regions. Last year the study was extended to cover practically all the important softwood species of the country. Data were obtained by visits to 41 mills throughout the softwood-producing regions, the tallying of 400,000 board feet of lumber, and the exact description of every defect occurring in the different grades. While analysis of the data has only begun, conclusions that are of great importance in selecting lumber for particular uses have already been established.

Another study contributing to the better selection of material concerns the differentiation of stock on the basis of density. Analysis of thousands of specimens of mill-run lumber has shown the normal variation of different items and species. Visual means of differentiating between dense

and light stock of various species are being developed.

The results of tests of large southern yellow pine and Douglas fir columns were prepared for publication. The relation between the test data, column formulas, and working stresses was presented in a form that, if properly used, will increase the outlet for grades of timber now difficult to market, by making possible the selection of columns that will maintain the correct load without excessive use of material.

The laboratory devoted a large share of its work to studies of moisture and moisture transfer in wood. The reactions of wood to changes in its moisture content form the greatest drawback to its use. A large volume of practical information on seasoning methods will become available in three forth-coming publications—the revised kiln-drying handbook, a general bulletin on the air seasoning of wood, and a bulletin on the kiln-drying of southern pine. Studies to reduce the variability of the moisture content of lumber as it comes from the air seasoning pile or from the dry kiln have been under way for several years. A study on the kiln-drying of Douglas fir was inaugurated during the current year, and further study was devoted to the devising of means for the instantaneous determination of the moisture content of wood.

A basic requirement for improving the seasoning of lumber and reducing the variability in the moisture content of the dry stock is knowledge of the conditions that actually obtain under present industrial practices. Extensive "moisture surveys" to obtain this knowledge were completed during the year, covering both summer and winter conditions. An intensive survey of moisture content and moisture range in a wide variety of items, made during the year in cooperation with the Southern Pine Association, has aided the association in adopting definite moisture specifications in its grading rules.

* To learn how dry wood needs to be for interior construction work, or for exterior, or for any other specific purpose, moisture content tests are under way in various regions.

MODIFYING PROPERTIES AND CHARACTERISTICS OF THE MATERIAL

The efficient use of wood demands not only a knowledge of its natural properties and how to adjust use to

them but also in many cases the modification of wood properties to fit the material to specific requirements. Generally this involves the use of accessory materials, such as preservatives, paint, fireproofing and moisture-proofing materials, and glues for veneered and built-up construction. Much has been done to extend and facilitate the use of preservatives in many fields. Studies of wood preservatives are being continued. One new result has been to show that the toxic action of many chemicals upon decay organisms can be roughly predicted from a knowledge of their chemistry. In connection with fireproofing studies a standard test on the inflammability of wood which appears better than those hitherto in public use was developed by the laboratory and informally approved by outside agencies.

Research in the painting of wood seeks both to lengthen the serviceable life of the paint coating and to give greater protection to the wood. Roughly, two-thirds of the softwood lumber cut of the country is found to be of species on which paint fails most rapidly. The principal objective in the continuation of the painting studies is to learn how to get better results on these woods. Much has been learned regarding the relationship between paint failure and board surfaces. The outstanding properties of wood affecting paint service are density and texture, the denser and coarser textured woods being the harder to keep painted satisfactorily.

Studies of the effect of the direction of grain in glued plywood panels, such as those used in doors and table tops, have shown how to lessen warping and cupping. The interrelations of temperature, viscosity, and consistency of glues and the surface conditions of the wood have been worked out and embodied in a recent department bulletin which is the most complete statement of modern wood-gluing principles that has yet appeared.

ADAPTING THE MATERIAL TO SERVICE CONDITIONS

Strength tests of full-size wall panels and other house parts, undertaken by the laboratory in cooperation with the National Lumber Manufacturers' Association, opened attack on the problem of scientific design for the frame house. Great gains from such studies are possible to the owners of houses and small buildings, in the form of better service and satisfaction at less cost. Builders, lumber manu-

facturers, and timber growers will also benefit. The small amount of testing thus far done points to many practical improvements in design that will result in greater rigidity and storm resistance, and in economy of material.

Ten per cent of the annual cut of lumber in the United States goes into shipping containers. As the population and commerce of the country increase, the demand for container material will expand. The laboratory studies the economical and efficient design of boxes and crates. Transportation hazards as related to the design of shipping containers were studied to learn their relative importance and how either to eliminate them or to design the commodity, the container, or the packing to withstand them. A study of carload shipments of canned foods in fiber boxes showed that about two-thirds of the damage to the boxes occurred in three clearly marked locations in the refrigerator car, and enabled improvements to be made in packing and loading to avoid the damage. This work is to be further continued and expanded.

CONVERSION OF THE MATERIAL INTO PULP PRODUCTS

The manufacture of pulp and paper products from wood is an outstanding field for the utilization of wood waste, little-used species, and second-growth timber of inferior quality. How to utilize a wide variety of species in many different wood-producing regions for a broad range of pulp products is the major research problem which the laboratory is seeking to solve. Success in this endeavor not only will secure improved land use and more complete wood utilization but also will lessen our present dependence upon foreign countries for much of our pulp and paper. The underlying knowledge required concerns the demands made of pulp products in commercial use, the properties of paper, pulp, and wood, and how these are affected by the production processes. Hence the properties of commercial papers of particular grades are being studied and mathematical relationships are being established between paper properties and structure. Certain specific pulp properties, such as particle size and extent of hydration, have been reduced to numerical measurement. These new yardsticks are particularly necessary in seeking to produce commercial mechanical pulp from species other than spruce—a matter of great importance. Shipments of pulpwood are now being

numerically evaluated relative to a wide range of physical and chemical attributes. The effects of duration and temperature of the pulping operation on the yield and quality of pulp in which alkaline reagents are employed have been expressed mathematically for the first time. Thus a few experiments may be made to delineate completely a wide range of pulping conditions by one numerical expression.

The past year has also been one of active progress in applied research. The work on producing strong white papers from southern loblolly pine has been extended to the improvement of the bleaching operation, the duplication of commercial white grades, and the evaluation of various lots of long-leaf pine. The duplication of commercial strong, light-colored papers from hardwood sulphite of gum, birch, maple, and aspen is proceeding successfully. The duplication of commercial print, wrapper, and manila papers has been accomplished by the use of the semisulphite process with eastern hemlock, balsam fir, aspen, and black gum. Progress was made in the utilization and disposal of sulphite-mill effluents, often the cause of stream pollution. A rough survey conducted in the Douglas-fir region indicates that enormous amounts of woods and mill waste can be effectively and doubtless profitably utilized by the pulp and paper industry if a satisfactory pulp and paper technique can be worked out. Attention is also being given to the development of a strong white pulp from threshed seed-flax straw. The possibility of developing a commercial feasible process for the utilization of this material now appears promising, owing to the discovery of means of cheaply separating mechanically the very valuable long-bast fiber from the woody shive.

RANGE INVESTIGATIONS

The object of range research is to determine or aid in determining how lands suitable for grazing can be made use of to best advantage, all things considered. Its results, while sought primarily in the interest of the administration of about 90,000,000 acres of national-forest land, are applicable also in varying degree to about 735,000,000 acres of other western range, public and private. Nearly all of this great area of 825,000,000 acres in the West will be used permanently for livestock pasturage. It is essential to learn not only how to maintain and increase its productive-

ness for this purpose but also how to preserve the watershed values that attach very extensively to the grazing lands, both timbered and untimbered, and both within and without the boundaries of the national forests.

The first appropriation for range research under the provisions of the McSweeney-McNary law was made during the year, bringing the total fund for range research in the Forest Service to \$67,000. The added \$14,320 will be used for the enlargement of range-research work in Utah, Nevada, and southern Idaho. Studies were continued by the Great Basin Experiment Station, in cooperation with the sheep experiment station at Dubois, Idaho, maintained by the Bureau of Animal Industry, to determine for spring-fall range the best time to begin grazing in the spring and to establish standards for judging when the forage growth is sufficiently advanced to be grazed without loss of range productiveness.

The proper utilization of range brush lands has been something of a moot question. A 5-year study conducted by the Forest Service in southwestern Utah, on ranges where browse constitutes 50 per cent or more of the forage, has proved that both range and livestock suffer when such predominant woody species as oak and service berry are closely grazed, and that carrying capacity should be based primarily on the more palatable vegetation present. A bulletin was prepared setting forth the forage value and requirements of the more important browse species of western range lands. Considerably over a thousand species of shrubby plants occur on these ranges, many of them in abundance, and they differ enormously in palatability and range relationships.

The results of accumulated research in artificial reseeding of western range lands were summarized in a bulletin published during the year. Western range areas having conditions which present knowledge shows to be favorable for reseeding with cultivated species are chiefly small, comparatively level mountain meadows, moist parks, and alluvial bottom lands having superior soil and moisture conditions. Kentucky bluegrass, common brome-grass, and timothy have been successfully established on a number of ranges; white clover has done very well in many moist areas on the west slopes of the Cascades, especially on sheep ranges; and sweetclover, especially in mixture, is valuable where it can be successfully established. About

20 of our native western range plants, chiefly grasses, have also been tried for artificial reseeding, with some promising results, but before much can be done to improve range conditions by their use adequate sources of seed supply must be created. At present slender wheatgrass is the only native western range grass of which the seed is on the market. Considering the enormous number of forage plants the experiments that have as yet been made have not gone very far. The possibilities of native plants, of exotic species, and of plant breeding to develop suitable varieties offer an extensive field for investigations. The encouraging results obtained with mountain brome grass and with slender and violet wheatgrasses suggest that the cultivation of native forage plants may eventually prove an important means of increasing range productivity.

A circular on the Angora-goat industry, issued last spring by the interdepartmental Angora goat and mohair committee, included information contributed by the Forest Service on management of the range and of goats on the range. Large areas of brush land are better suited to and more profitably utilized by goats than by other classes of livestock, and the Angora-goat industry has expanded enormously within the past few years. Many of the ranges are seriously overgrazed. With better knowledge on the part of growers as to how closely the ranges should be grazed and what management methods should be employed, the prospects of the industry for permanence and further development will be improved.

Studies of various important range grasses gave enlarged knowledge of the best methods of utilizing them and of the degree of intensity and frequency of grazing to which each species can be subjected without impairing its vigor and production of forage.

The need for regulated range use on a very large scale in the more arid parts of the West, to insure favorable watershed conditions as well as range productivity, is only beginning to be understood. Through systematic range research new and highly significant information is being obtained. There is a much closer analogy between the range vegetative cover and the protective cover afforded by the forest than has as yet been recognized in common thought. The same principles apply to both, and the same need exists for measures of public control to prevent destructive practices. This is true not only with regard to the large part of the western range lands now embraced

within the national forests but also with regard to much of the outside range, both public and private.

At the Great Basin Experiment Station, in Utah, study of the relationship between range use and watershed conditions was continued. On high mountain watersheds it was found that an increase in the vegetative cover that caused it to occupy 40 per cent of the soil surface as against an earlier 16 per cent reduced the summer surface run-off 55 per cent, and the volume of sediment eroded 56 per cent. Noneroded soil was found to be much more fertile and of greater water-holding capacity than eroded soil, and its vegetation had more leaves, greater stem and leaf length, and a greater production of dry matter with a smaller quantity of water.

Erosion on granitic soils in Idaho is affecting timber, range, mining, agricultural, power, and recreational values. Over 850,000 acres of agricultural land are irrigated by water from watersheds made up of these soils, and over \$31,000,000 is invested in irrigation enterprises. Every drop of water from the watersheds is needed to maintain the present irrigation developments. Excessive erosion is taking place, stream flow is diminishing, and reservoirs are seriously silted. The vegetative cover on extensive areas has largely been destroyed through overgrazing. Fire, placer mining, and other influences have contributed to erosion. Research to learn how to retain and improve the vegetative cover on these watersheds is imperative. Recent measurements have disclosed that the Arrowrock Reservoir, in central Idaho, is accumulating an amount of silt that threatens to shorten the life of the reservoir materially. Studies will be made to determine how far the grazing of livestock on the Boise National Forest is responsible, and what corrective measures will be required.

The Tonto National Forest, in Arizona, is one of the principal watersheds of the Salt River irrigation project. The range studies there have shown that the ground cover has broken down seriously in many places, and extensively. The change has been going on for 50 years and has taken place so gradually that it has escaped notice. How much of the original vegetation has disappeared and how extensive is the resulting erosion of the surface soil and silting of the irrigation reservoirs research is now making clear. Fortunately the investigation has indicated also that under

proper protection the original conditions of soil and vegetation can be gradually reestablished. The enormous values in irrigated farm properties and in city real estate and industries far outweigh the values represented in the livestock enterprise dependent upon these watersheds.

In the Salt River valley many crops have been curtailed or eliminated because of a decrease in the water supply. Low water in the Roosevelt Reservoir has reduced the production of electric power. It has been necessary for the water users to borrow heavily from the banks. Serious consequences of erosion are manifested in the condition of the watershed and the unsatisfactory run-off. More than enough water went over the spillways in 1920 to fill the part of the reservoir now occupied by silt. The present irrigation works cost over \$21,000,000, and 300,000 acres of land are irrigated. Two hundred and fifty million dollars of farm and urban property are involved; the crops and livestock amount annually in value to \$30,000,000. The value of power produced in 1928 was \$5,000,000. It is believed that a sys-

tem of range management can be devised that will adequately protect the soil and ground cover without imposing very great hardships upon the stockmen.

The ranges and watersheds of the Southwest should be studied to determine what kinds of vegetation can be increased; what protection from erosion is afforded by different densities of vegetation on the major soil types; how grazing can favor recovery of vegetation and the rapidity of its reestablishment; how grazing influences run-off and erosion by removal of part of the current vegetative growth, by trampling, and by destruction of the stand; the practicability of artificially reseeding or replanting range areas to check erosion; the practical value of check dams, terracing, and other engineering features under the semidesert conditions of these watersheds; the comparative economic value of the watersheds for supplying irrigation water and for grazing; and the possible advantage of changing from the present yearlong cattle grazing to winter grazing by sheep, for which there is now an intense demand.

EXPENDITURES AND RECEIPTS

The expenditures for all purposes during the fiscal year were as follows:

General administration.....	\$392,453.86
Forestry extension.....	31,570.38
Research:	
Silvical investigations.....	\$462,539.75
Forest products investigations.....	633,072.22
Range investigations.....	89,032.16
Taxation study.....	61,493.50
Total.....	1,246,137.63
Administration, protection, improvement, reforestation and extension of the national forests:	
Administration—	
Timber use.....	\$1,248,367.69
Grazing use.....	1,024,103.46
Fish and game protection.....	115,470.41
Recreation and land use.....	224,548.92
Examination and administration of power sites for Federal Power Commission and support of its personnel.....	22,045.00
Classification, settlement, and claims.....	71,276.97
General surveys and maps.....	165,247.27
Grazing reconnaissance.....	117,615.81
Timber surveys.....	245,666.79
Subtotal.....	3,234,342.32
Protection—	
Fire protection and detection.....	1,954,372.07
Fire suppression.....	1,532,491.55
Protection against insects and tree diseases.....	129,708.83
Subtotal.....	3,616,572.45

Administration, protection, improvement, reforestation and extension of the national forests:—Continued

Improvement—

Construction of improvements other than roads, trails, and camp-ground improvements.....	941,465.58
Maintenance of improvements other than roads, trails, and camp-ground improvements.....	677,138.00
Camp-ground improvements.....	41,047.00
Construction and maintenance of roads and trails—	
10 per cent fund under act of Mar. 4, 1913.....	\$419,179.32
Cooperative construction of roads and trails under act of July 11, 1916.....	164,942.29
Federal forest-road construction under act of Feb. 28, 1919.....	13,263.07
Forest-development roads and trails under act of Nov. 9, 1921.....	3,801,944.98
Forest highways under act of Nov. 9, 1921.....	5,100,359.88
Road and trail construction from moneys contributed by cooperating agencies under act of June 30, 1914.....	1,162,424.22
Contributed from other appropriations.....	492,093.09

Class total (roads)..... 11,154,206.85

Subtotal..... 12,813,857.43

Reforestation—

Nurseries and tree planting..... 271,545.11

Extension—

Land exchanges..... 129,565.23

Acquisition under act of Mar. 1, 1911, as amended..... 1,042,624.62

Subtotal..... 1,172,189.85

Total..... 21,108,507.

Protection and reforestation of other than national forest lands—

Tree planting in cooperation with States under act of June 7, 1924..... 75,187.59

Fire protection in cooperation with States under act of June 7, 1924..... 1,146,530.82

Protection of Oregon and California grant lands..... 68,791.00

Total..... 1,290,509.

Grand total..... 24,069,178.

In addition to the expenditure for land extension itemized above in the entries "land exchanges" and "acquisition under act of March 1, 1911," national-forest timber having an estimated value of \$448,240 was cut under agreements involving the acquisition of land and timber through exchange. The cash disbursements recorded under "land exchanges" cover merely the outlay incidental to examining lands offered for exchange and appraising the values involved.

The cash receipts from the national forests were as follows:

From the use of timber.....\$4,108,595.00
From the use of forage..... 1,740,289.81

From miscellaneous uses, including the use of land, water-power sites, etc.... 450,917.00

Total..... 6,299,801.81

The total is greater by \$858,201.11 than that for the previous year. Receipts from timber increased \$783,349.84. Grazing receipts were greater by \$26,559.66 and miscellaneous receipts by \$48,291.64.

In addition to the cash receipts from timber there should be credited the value of the timber cut under specific agreements for effecting land exchanges, estimated at \$448,240.

REPORT OF THE FORESTER

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., September 25, 1930.

SIR: I transmit herewith the report of the Forest Service for the fiscal year ended June 30, 1930.

Respectfully,

ROBERT Y. STUART, *Forester.*

HON. ARTHUR M. HYDE,
Secretary of Agriculture.

THE FEDERAL FOREST POLICY

A Federal policy of forestry has been developing for almost 60 years. It has been built up by successive legislative enactments and the resulting activities. It is not a specific and limited program, but rather is the gradual unfolding of a national purpose.

That the American people are in favor of forest conservation as a public policy admits of no dispute. Extensive further forest destruction is held undesirable and injurious to the public welfare, and there is strong popular desire not only to have the present forests protected and maintained but also to have forests restored where man has removed them without subsequently putting the land to other use. The steady progress of legislation, State and Federal, decade after decade, and the growing public function in the field of forestry witness to this.

The Federal forest policy expresses the conviction of the people of this country that public action is necessary to insure the perpetuation and wise use of the forest resource and that the Nation through the Federal Government can best undertake certain portions of the task. The policy does not seek narrowly or merely to insure future wood supplies, nor merely to protect water resources, nor merely to obtain the indirect benefits and intangible satisfactions that forested areas provide. It is a policy based on a broad and deep-seated belief that if the forests are allowed to vanish the national welfare will suffer. It recognizes that forest preservation must be based on forest usefulness, but for the satisfaction of varied human needs.

This purpose of forest perpetuation as a public end gave strength to the early national-park movement, which in its initial stages made no functional differentiation between national parks and national forests. It had much to do with the attempt to bring about

forest establishment in the treeless regions through the timber culture act of 1873—a false first start in the field of Federal forest policy; and it had a large part in bringing about, upon the repeal of the timber culture act in 1891, the provision of law authorizing the President to create forest reserves.

For more than a decade previously the forest conservationists had been urging that all the public-domain timberlands should be reserved and placed under permanent administration. The law of 1891 made possible some progress toward this goal, although for a number of years there was no certainty that a permanent accomplishment of substantial proportions would follow. The law of 1897 established guiding principles that afforded a basis for eventually orienting and developing along permanent lines the national forest administrative policy. But the public purpose that finds its expression in the present Federal forest policy is of much broader scope than is represented by the national forest enterprise, great as that has become. It is a purpose which takes in not merely the minor fraction of the forests of the United States now owned or to be owned by the Federal Government, but all the forests of the United States.

The aim of the Federal forest policy is to bring about the highest use of the forest as one of the country's great basic resources. It recognizes that there exists at the present time a serious maladjustment of use to the character of the resource. In consequence of this maladjustment, which is partly an inheritance from an earlier stage of our national economic life, the forest is customarily used as a wasting resource. Men draw upon it to supply their needs without provision for its perpetuation and without care for its welfare. Progressive deterioration is the result; and this is a cause of community and regional loss, sometimes to the point of impoverishment. For this whole condition of maladjustment and unskillful, careless or consciously destructive treatment of the forest the Federal forest policy is endeavoring to find correctives.

One of the most essential requirements for the effective application of forestry, either by public or by private owners, is adequate scientific and technical knowledge of the resource and of the best ways to handle it. Only technical foresters realize how enormous is the task of building up the knowledge on which sound practices and efficient use of our immensely complex and varied forest resource must rest. It is a task comparable in many ways with that of building up the whole body of agricultural knowledge on which rests successful and profitable farming in all parts of the country. The accumulation and dissemination of illuminative knowledge regarding forestry has been a Federal policy ever since 1876, when Congress appropriated \$2,000 to begin forest investigations in the Department of Agriculture. In the last few years provision for forest research by the Forest Service has been on a much broader scale than ever before.

The summary of the work done last year, which is given in the latter part of this report, shows something of its varied character, extensiveness, and practical value. Even so, in comparison with the urgent need for better knowledge the work is still inadequate. The Federal Government should assume the principal burden of obtaining the body of detailed and scientific knowledge which systematic

research must provide if the forests of the United States are to be put to their best use and perpetuated through wise and skillful handling. No other agency can be expected to do it, and the interest served is the national interest. A Federal forest policy shaped to meet fully the needs of the country would necessitate a very substantial expansion of the present forest research activities of the Government.

Another corrective which the Federal forest policy aims to apply is the organization of joint effort by the National Government and the States to facilitate private forestry. To bring about organized and efficient protection and constructive management of the forests of the whole country is of manifest and primary importance. A Federal policy of cooperation with the States is now in effect to these ends. The Nation offers to the States that will maintain protective systems against fire a contribution that by law may not exceed one-half the outlay. Under the same limitation, Federal contributions are also made to the States for the production and distribution of forest trees for planting and for advice to forest-land owners in the constructive management of their properties. More substantial and promising results, on the whole, have been attained in the forest protection cooperative effort than in forest replacement and forest perpetuation projects. It should be stated, however, that the total cooperative effort falls short of the needs of the situation. Forest protection and perpetuation on private forest lands is inadequately assured. Greater public and private effort is necessary.

The principal contribution of the Federal forest policy to bringing about the best use of the forest resources of the United States has been in connection with national-forest administration. The development of that policy, it is true, took place slowly for some years after the law of 1897 gave it definite direction, nor has it ever been extended to all the Federal lands to which it is in principle suited. With respect to the extent to which the President should make forest reserves the law of 1897 went no further than acceptance of what had already been done and continuance of authority for making more reservations; but it laid down very important governing principles regarding the lands that might be put into these reservations. Forest reservations might be established to "improve and protect the forest" or "for the purpose of securing favorable conditions of water flows" and to furnish "a continuous supply of timber for the use and necessities of citizens of the United States." These three authorized purposes afforded a touchstone for determining what character of public lands Congress designed to have included in the reserves.

For the administration of the reserves the same act specified as the controlling objects "to regulate their occupancy and use and to preserve the forests thereon from destruction" and authorized the Secretary in charge to make such rules and regulations and establish such service as would insure the attainment of these ends. This authorization was the enabling act of national-forest administration and made possible the development of the main features of the national-forest policy of to-day. Its central purpose is to obtain from the resources the largest net total of public benefits. As this

purpose has, during the last 25 years, taken form and demonstrate its workability and public value, the resulting approval has been the chief factor in determining, up to the present time, the scope of the enterprise.

For years the whole policy of reservation hung in the balance. After the major part of the public domain timberlands had been placed in national forests Congress withdrew from the President authority to add further to the national forests in most of the western public-land States. After having increased very rapidly in area during most of the first decade of the century, the national forests experienced a decade of decline. During this second decade, too, considerable legislation was before Congress which if enacted would have crippled or abolished the whole national-forest system. On the other hand, the third decade of the century has been one of slowly increasing national-forest area. It may well be asked what national policy, if any, appears to be taking form with respect to the ultimate scope of the western national-forest enterprise.

That it is heartily approved by an overwhelming weight of western public sentiment is beyond question. Instead of wishing to curtail the national forests many westerners now desire their extension. Congress has passed a number of laws making specific additions sought by local communities. It has passed a general exchange act as well as a long roll of specific exchange acts, which are bringing about substantial increases of the area under administration. It has authorized the Secretary of Agriculture to determine the location of public lands chiefly valuable for stream-flow protection or timber production, which can be economically administered as parts of national forests, with a view to the communication of his findings to Congress for such further action as Congress may deem fitting. The threat of large-scale abandonment of privately owned cut-over timberlands in some western localities is creating an additional demand for national-forest extension to give these abandoned lands a chance to reforest. Some timberland owners are inquiring regarding the possibility of donating their lands, subject to the privilege of cutting the timber later under forestry regulations, and local demands for the protection of watershed lands on the open public domain are creating new proposals for additions to the forests.

The time is auspicious for determining the scope of the western national-forest enterprise along more logical lines than have hitherto governed action. Twenty-five years of forest-resource administration by the Forest Service has afforded a demonstration of what can be done under public control to provide harmonized, correlated use of all the resources. The period of experiment and demonstration is over. It is possible to proceed functionally.

There still remains in the hands of the Federal Government substantial acreage of public lands suitable for national-forest administration for the purposes specified in the law of 1897. There are many millions of acres of timberland in the interior of Alaska which are now almost without protection and seriously ravaged by great fires each year; there are some millions of acres of public domain timberlands in the continental United States, the future of which is altogether uncertain; there are very extensive areas

public lands requiring controlled use of the vegetative cover to prevent disastrous erosion, flood damage, and water waste. In addition, there are some millions of acres of privately owned timber land within or adjoining the national forests which should be handled as integral parts of the forests under the same management plan, through a blocking-up process now actually under way, though at an inadequate rate, by means of the land exchange authorizations; and there is the prospect of an accumulating area of idle cut-over lands which the owners will not wish to retain and which it would be a very bad public policy to leave uncared for and nonproductive. Thus the scope of the general forest undertaking, which for the best interest of the West it will be necessary for some public agency to assume, begins to take on definiteness.

To some degree State forestry is entering the Western field. It should be encouraged and built up by all available means. However, if the Western States provide for the lands of their own that are suitable for forest administration, together with the lands that will revert to public ownership through tax forfeiture and those that adequate State policies of forestry will make it necessary for the States otherwise to acquire, it is improbable that they will wish to assume any heavier responsibilities. In short, the public lands forest problem is likely to remain a Federal problem. As a Federal problem, the best course for its solution is reasonably obvious. Let the governing principles laid down by Congress in the law of 1897 be applied. This would mean that wherever opportunity exists through national-forest administration to "improve and protect the forest," or to serve "the purpose of securing favorable conditions of waterflow," or to furnish "a continuous supply of timber for the use and necessities of citizens of the United States," public lands should not be disposed of, but should be added to the present area of the national forests and protected and administered accordingly. The national forests in the eastern half of the country represent a Federal enterprise distinct from that in the Western States. The Western enterprise is based on a policy of public-land reservations in the States where the Federal Government has always owned most of the virgin forest area. The eastern enterprise is based on a policy of recovering from private ownership such limited portions of the East forest area as peculiarly call for public administration either for the sake of stream-flow regulation or (since the law of 1924 was passed) for timber production. This is true notwithstanding the fact that much of the land in the eastern national forests has come through the reservation of unappropriated remnants of the public domain in a few States.

Later on in this report the present program of acquisition for the rebuilding of the national-forest system of the East is outlined. Unlike the western system, it can not play a principal rôle in determining what the general forest conditions of the region shall be, save the public forests may by example and education influence private forest policy. It can not, unless greatly expanded beyond its present scope, begin to take care of the interests of the East in water conservation through forest administration. Still less can it serve as a basis for public assurance of adequate future timber supplies for the

East. The eastern national-forest enterprise embodies a policy limited Federal aid in and assumption of responsibility for protecting public interests that are in part State interests. It therefore cannot be thought of as an adequate policy of public ownership for the East by itself. Failing complementary State policies, the field public forest administration in the East will be left in large measure unoccupied unless the scope of the Federal enterprise is greatly enlarged.

PROGRESS IN STATE FORESTRY LEGISLATION

Although comparatively few of the State legislatures held session during the year, a number of States materially strengthened the forestry laws.

Porto Rico attempted to solve the forest-tax problem in a manner like that adopted by many of the States, through total exemption of land and timber after lands are classified as auxiliary insular forests. Kentucky substituted for its previous forest tax law, which had been declared unconstitutional, a leasing provision as a part of a new law for the establishment of forest reserves suited to the growth of timber and the propagation of wild-animal life. Land for these reserves may also be acquired by purchase, escheat, donation, and from delinquent-tax sales. Where lands are leased the term must be not less than 20 nor more than 100 years, and the rental may not exceed the amount of State, county, and school taxes on the land, which the owner continues to pay. When merchantable timber is taken from the leased lands one-half the stumpage value of the timber is paid to the lessor or his assigns and the other half goes into the State treasury and is credited to the forest department.

New York amended her tax law by extending its application to forest plantations instead of only to plantations made since January 1, 1921, and by providing that at no time shall the land be assessed at a higher valuation than that at the time when classification was or may be applied for. Also, the system of fixing the assessment was altered to make it conform to the system applied to land generally.

Virginia provided that, subject to county approval, the department of conservation and development may set up forest, game, fish, and recreation reserves, comprising private forest lands or lands suited to the growth of timber, whose owners may offer them for this purpose. If such reserves are established, the department on assumption of control is obliged to protect them, to stock them with game and fish, and to sell hunting, fishing, and recreational privileges. The landowners obtain a postponement of the payment of taxes, with interest at 6 per cent, for not longer than 40 years; or alternatively they may receive annually one-half of the receipts from the sale of hunting, fishing, and recreation privileges, while paying all taxes annually. A temporary commission was created by Virginia to investigate forestry and forest taxation, to study the different methods of promoting forestry in the various States, including methods of taxing forests and waste lands, and to report their findings and recommendations.

recommendations by January 1, 1932. Wisconsin amended its income tax law to allow the deduction from income of expenditures for planting or protecting a forest crop on lands registered under the forest crop law.

A number of States strengthened their forest-fire legislation. Kentucky provided that if owners of private forested lands fail to provide a sufficient patrol the State will furnish such protection at a charge of not to exceed 1 cent per acre per year. This provision does not apply to members of the various fire-protective associations now in existence. The penalties for unlawfully causing forest fires were made more severe, and mutilation or removal of posted notices of the State forest service was made a crime punishable by fine or imprisonment or both. Massachusetts gave the State forester power to order forests to be put under patrol by the town wardens at times of extreme drought with partial or entire State reimbursement of the cost, and also strengthened the restrictions upon setting fires in the open air. Mississippi made all county sheriffs reforestation wardens charged with duties that include enforcing the State reforestation laws and all rules and regulations of the State forestry commission and with authority to call on any citizen in a forest-protection area to assist in preventing or controlling forest fires.

An amendment to the New York State Constitution giving power to contract debts for the suppression of forest fires was adopted at the last general election by a vote of 3 to 1. The forest-fire laws of Rhode Island were amended in certain details. Virginia made refusal or failure to assist in fire fighting when summoned by fire wardens a misdemeanor, and regulated the building of fires in the open air, with penalties for failing to extinguish such fires.

Federal land acquisition for national-forest purposes was given a broader field in Wisconsin, which increased the maximum from 100,000 to 1,000,000 acres; in Georgia, which amended the enabling act to include the Okefenokee Swamp; and in Porto Rico, where the area of land that may be acquired is now unrestricted.

Kentucky authorized the governor to accept donated lands as State forest reserves, to be administered by the State forest service. Massachusetts increased the maximum acreage of lands to be acquired for State forests by 50,000 acres. The Department of Agriculture and Labor of Porto Rico was authorized to acquire lands by purchase or by the exercise of the power of eminent domain, to be used for forestry purposes as part of the insular forest reserve. The lands must be suitable for the production of wood products or for the conservation and regularization of the water currents or heads of rivers of the island, and the purchase price must not exceed \$20 per acre. Texas appropriated \$25,000 to purchase virgin State forest land lying in the longleaf-pine section of the State.

Virginia provided that tax-delinquent lands bid in by treasurers for the benefit of the State and certain waste and unappropriated lands of the Commonwealth chiefly valuable for forestry purposes may be set apart permanently as State forest land by proclamation of the governor. Wisconsin empowered the conservation commission to sell State lands and use the funds for blocking up State or county

forest lands; authorized the State or any county to exchange land for other lands, whether publicly or privately owned; increased the powers of county boards to acquire county forests; amended the county zoning law to cover areas to be used for agriculture, forestry and recreation; and relieved counties taking tax deeds from the necessity of satisfying the tax claims of the State prior to sale of the land, or, if the land is entered under the forest-crop law, until the forest crop is taken off.

Georgia required that instruction to teach the practical value of conserving and protecting forests shall be included in the curriculum of all public schools in the State. Massachusetts made it an offense to throw any lighted cigarette, cigar, match, ashes, or flaming substance from any vehicle, where it is likely to cause a forest fire.

New York extended the legislative reforestation commission for an additional year and gave the conservation commissioner authority to establish and maintain nurseries to produce trees for planting along highways, with a \$14,000 appropriation for initiating this work. An amendment to the State constitution was initiated the purpose of which is to assure adequate appropriations to make fully effective the State's enlarged reforestation program by providing \$19,000,000 over a period of 11 years, for the acquisition and reforestation of land, the management of forests thereon, and the establishment of forest-tree nurseries therefor. Two other constitutional amendments were initiated to permit the construction within the forest preserve of recreational facilities and State and county highways, with the necessary clearings.

WORK OF THE YEAR IN STATE COOPERATION

Table 1 shows the appropriations for cooperative work with States during the fiscal year 1930, in comparison with 1929 and 1931.

TABLE 1.—*Appropriations for State cooperation, 1929-1931*

Item	Amount appropriated for fiscal year—		
	1929	1930	1931
For the prevention and suppression of forest fires and for the forest taxation inquiry (secs. 1 to 3 of the Clarke-McNary law).....	\$1, 200, 000	\$1, 400, 000	\$1, 700, 000
For the distribution of forest planting stock to farmers (sec. 4 of the same law).....	75, 000	83, 000	93, 000
For farm forestry extension (sec. 5 of the law, administered by the Office of Cooperative Extension Work).....	60, 000	65, 000	65, 000

The results of the work are summarized below, except for the taxation study, which is covered on page 59. Table 2 shows in detail the Federal, State, and private funds disbursed by the States expended under their supervision for the prevention and suppression of forest fires, and the Federal and State funds disbursed by the States for the production and distribution of planting stock.

TABLE 2.—*Cooperative expenditures for fire protection and for the distribution of forest planting stock under the Clarke-McNary Act, fiscal year 1930*

State	For fire protection				For the distribution of forest planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Alabama.....	\$42,090.00	\$46,048.45	\$23,743.58	\$111,882.03	\$2,000.00	\$2,000.10	\$4,000.10
California.....	93,627.00	174,975.68	304,565.98	573,168.66	797.00	799.34	1,596.34
Colorado.....					2,000.00	2,049.76	4,049.76
Connecticut.....	11,262.00	56,375.27	6,726.59	74,363.86	2,000.00	4,091.47	6,091.47
Delaware.....	919.00	1,937.88		2,856.88	2,000.00	4,295.59	6,295.59
Florida.....	37,017.00	44,200.03	51,494.77	132,711.80	1,357.00	3,133.96	4,490.96
Georgia.....	40,664.00	18,274.51	30,954.83	89,893.34	2,000.00	2,496.77	4,496.77
Hawaii.....					2,600.00	16,326.98	18,926.98
Idaho.....	64,040.00	110,408.08	383,221.16	557,669.24	899.40	899.40	1,798.80
Illinois.....	2,179.00	6,798.59	1,030.00	10,007.59			
Indiana.....	1,700.00	2,264.32		3,964.32	2,000.00	8,028.73	10,028.73
Iowa.....					2,000.00	2,120.03	4,120.03
Kansas.....					2,000.00	3,528.86	5,528.86
Kentucky.....	12,719.15	12,719.15		25,438.30	2,000.00	2,714.08	4,714.08
Louisiana.....	41,530.00	66,594.63	25,100.78	133,225.41	1,442.67	1,442.68	2,885.35
Maine.....	52,965.00	157,890.53		210,855.53	757.44	757.43	1,514.87
Maryland.....	10,169.00	32,105.20	3,306.40	45,580.60	2,000.00	5,233.61	7,233.61
Massachusetts.....	29,417.00	100,567.59		129,984.59	2,175.00	7,115.35	9,290.35
Michigan.....	81,410.00	487,982.27		569,392.27	2,100.00	6,448.85	8,548.85
Minnesota.....	85,268.00	292,743.05	48,375.30	426,386.35			
Mississippi.....	9,596.43	29,500.00		39,096.43	326.15	326.16	652.31
Missouri.....	7,940.85	7,940.86		15,881.71	1,405.24	1,392.10	2,797.34
Montana.....	26,369.00	14,163.69	49,099.22	89,631.91	2,000.00	2,822.42	4,822.42
Nebraska.....					2,200.00	10,136.00	12,336.00
New Hampshire.....	17,132.00	41,722.38	7,189.81	66,044.19	2,100.00	3,720.00	5,820.00
New Jersey.....	20,442.00	33,546.67		53,988.67	2,300.00	14,564.00	16,864.00
New Mexico.....	581.00	5,423.00		6,004.00			
New York.....	65,201.00	296,551.09		361,752.09	6,000.00	124,845.43	130,845.43
North Carolina.....	44,757.00	63,870.64	9,877.96	118,505.60	2,000.00	2,606.04	4,606.04
North Dakota.....					2,100.00	5,220.11	7,320.11
Ohio.....	5,485.00	22,392.40		27,877.40	2,150.00	13,076.51	15,226.51
Oklahoma.....	14,429.00	10,052.41	12,014.00	36,495.41	2,000.00	4,440.81	6,440.81
Oregon.....	86,345.00	39,884.52	133,535.74	259,765.26	2,000.00	2,384.10	4,384.10
Pennsylvania.....	50,181.00	327,438.72		377,619.72	2,550.00	21,834.37	24,384.37
Porto Rico.....					2,225.00	16,805.79	19,030.79
Rhode Island.....	1,886.00	9,220.17		11,106.17			
South Carolina.....	18,196.43	8,631.53	9,729.09	36,557.05	2,000.00	2,536.60	4,536.60
South Dakota.....	375.00	5,229.00		5,604.00			
Tennessee.....	23,619.00	23,672.86	9,275.81	56,567.67	2,005.40	4,472.22	6,477.62
Texas.....	32,661.00	39,540.97	10,221.59	82,423.56			
Utah.....					1,300.00	1,300.00	2,600.00
Vermont.....	7,694.00	8,384.87	5,214.44	21,293.31	2,200.00	5,910.93	8,110.93
Virginia.....	32,814.00	40,628.53	8,780.12	82,222.65	2,000.00	4,382.79	6,382.79
Washington.....	93,479.00	106,136.98	52,915.05	252,531.03	1,934.90	1,934.90	3,869.80
West Virginia.....	22,733.00	25,141.78	10,632.87	58,507.65	699.55	699.56	1,399.11
Wisconsin.....	38,527.00	141,511.14		180,038.14	2,000.00	2,002.64	4,002.64
Wyoming.....					1,138.60	1,138.60	2,277.20
Administration and inspection.....	75,274.40			75,274.40	1,715.97		1,715.97
Total.....	1,302,694.26	2,912,469.44	1,197,005.09	5,412,168.79	80,479.32	322,035.07	402,514.39
Forest tax studies.....	64,159.98						
Unexpended balance.....	33,145.76				2,520.68		
Total appropriation.....	1,400,000.00				83,000.00		

In addition to the expenditures made to carry the specific cooperative projects shown in Table 2 a substantial sum was expended independently by private individuals and associations and by counties. The sum so reported for the calendar year 1929, the last year of record for this class of expenditure, was \$270,000. The actual sum was undoubtedly much larger.

COOPERATIVE PROTECTION OF STATE AND PRIVATE FOREST LANDS FROM FIRE

For the calendar year 1929 the area of forest or potential forest land under State and private ownership which was reported by the cooperating States as under some form of systematic protection from forest fires was approximately 224,000,000 acres. This is 4 per cent of the 417,000,000 acres of State and private forest land classified in 1930 as needing such protection. A gain of approximately 46,000,000 acres since 1925 in the area under protection evidences that progress is being made, but the gap of 193,000,000 acres between the area protected and that needing protection points out the problem which still remains. Of this still unprotected area 8 per cent, or 154,000,000 acres, lies in the Southeastern and Gulf States. With the Central States added the unprotected area becomes 180,000,000 acres, or 93 per cent of the total for the entire country. The situation constitutes a challenge to the South.

The greatly increased interest in forest conservation in that region promises well. It is being substantially enlarged by the educational work which the American Forestry Association has been carrying on with the States of Georgia, Florida, and Mississippi during the past two years. Another hopeful feature is the active interest of many timberland owners, manifested in \$202,855.40 contributed last year by private owners to the cooperative forest fire protection fund in the 17 Southeastern, Gulf, and Central States. There is, however, an outstanding failure on the part of many of these States to provide substantial State appropriations for the work.

With \$13,367,500 estimated as necessary to do a complete job and only \$6,069,000 spent in 1929 for this work, the need of much larger State, Federal, and private funds is manifest. Substantial increases in State appropriations would have far-reaching effects.

Revised estimates of the acreage of State and privately owned forest land needing protection from fire and of the cost of protection were completed during the year and are shown in Table 3.

TABLE 3.—*Area and cost estimates for protection of State and private forest land 1930 revision*

State	Area of forest or potential forest land	Estimated cost of protection	State	Area of forest or potential forest land	Estimated cost of protection
	<i>Acres</i>	<i>Dollars</i>		<i>Acres</i>	<i>Dollars</i>
Maine.....	14,957,000	342,000	Oklahoma.....	12,388,000	165,000
New Hampshire.....	4,259,000	131,000	Arkansas.....	22,000,000	484,000
Vermont.....	3,375,000	57,000	Ohio.....	2,160,000	60,000
Massachusetts.....	3,300,000	169,000	Indiana.....	3,000,000	84,000
Rhode Island.....	280,000	17,000	Illinois.....	2,750,000	77,000
Connecticut.....	1,500,000	76,000	Kentucky.....	9,000,000	212,000
New York.....	11,689,000	378,000	Tennessee.....	10,430,000	245,000
New Jersey.....	1,906,000	128,000	Missouri.....	15,750,000	347,000
Pennsylvania.....	12,365,000	364,000	Michigan.....	18,596,000	662,000
Delaware.....	325,000	12,000	Wisconsin.....	13,187,000	390,000
Maryland.....	2,200,000	73,000	Minnesota.....	20,523,000	697,000
Virginia.....	14,005,000	397,000	South Dakota.....	79,000	4,500
West Virginia.....	9,251,000	312,000	Montana.....	4,854,000	190,000
North Carolina.....	20,568,000	632,000	Idaho.....	4,601,000	447,000
South Carolina.....	12,500,000	378,000	Washington.....	12,080,000	632,000
Georgia.....	23,100,000	775,000	Oregon.....	10,685,000	584,000
Florida.....	22,900,000	847,000	California.....	18,955,000	969,000
Alabama.....	22,386,000	573,000	New Mexico.....	1,800,000	26,000
Mississippi.....	19,500,000	563,000			
Louisiana.....	17,900,000	434,000			
Texas.....	15,657,000	434,000	Total.....	416,761,000	13,367,500

The totals are greater than those of previous estimates, as was to be expected, since many of the former State estimates had to be made before systematic work had been undertaken and were conservative. It is also true that in many States the area of forest and potential forest land has increased during the last decade, through the abandonment of submarginal farm lands. This does not mean, however, that the areas of forest land of present merchantable value have increased. The new estimates were used in determining the allotment of Federal funds to the States for cooperative fire protection for the fiscal year 1931.

In response to a request from the Governor of Arkansas a survey was made under the terms of section 1 of the Clarke-McNary law to determine means by which privately owned and State-owned forests in Arkansas could be adequately protected from forest fires. The results of this study will be published and distributed early in the fiscal year 1931 by the Arkansas Extension Service, which, with the Arkansas Forest Protective Association, constituted the principal local cooperators.

The total area reported as burned over in the calendar year 1929 on lands protected by the States or the Forest Service was 4,876,000 acres, as against 4,111,000 acres in 1928; and on unprotected areas, 41,354,000 acres, as against 39,431,000 acres in 1928. For unprotected areas the available data are too fragmentary and inexact to permit of more than rough estimates, though they are constantly growing better. Their roughness does not impair the essential significance of the fact that 89 per cent of the total area burned over was non-protected land. This is hopeful, provided rapid progress can be made in placing all the land under protection. Within protected units, 4,876,000 acres were reported as burned over, or 1.22 per cent of the land. The same percentage applied throughout would have made the area burned by all forest fires 7,196,000 acres, as against the estimated 46,230,000 acres.

COOPERATION WITH STATES IN TREE PLANTING

Farmers of the continental United States and the Territories of Hawaii and Porto Rico were supplied with more than 25,000,000 young forest trees from the nurseries of the States and Territories cooperating under section 4 of the Clarke-McNary law. This meant timber production initiated or restored on more than 25,000 acres of farm lands. Most of the cooperating States distributed more trees than in 1928, but in New York and Pennsylvania the number decreased by nearly 5,000,000, partly because these States were unprepared to furnish the desired quantities of certain kinds of trees which have recently become popular for planting. In addition, to secure greater success, especially when the planting is large, Pennsylvania now encourages spreading the work over several seasons rather than attempting to do it all in a single year. This has somewhat decreased the immediate demand for trees.

Material increases in the number of trees distributed from the various State nurseries in the South evidenced an awakening interest here in timber as a farm crop, while recognition of the value to farms of shelter belts and wood lots has resulted in constantly growing demands for planting stock in the Plains States.

Improvement of the Forest Service seed-extraction plant on the Chippewa National Forest in Minnesota will make possible the furnishing of all the Norway pine seed needed by the cooperating States at a moderate cost. The seed of other species native to the United States will also be furnished so far as the supplies will permit.

The addition during the year of the State of Utah increased the number of cooperating States and Territories to 41. The allotments and expenditures are shown in Table 2.

COOPERATION WITH STATES IN FARM FORESTRY EXTENSION

Federal cooperation in farm forestry, authorized under section of the Clarke-McNary law, is conducted as a part of the extension program of the several State agricultural colleges, and is administered by the Extension Service of the Department of Agriculture with the cooperation of the Forest Service. The Federal appropriation of \$65,000 for the last fiscal year was used mostly for the employment of extension foresters.

Increased concrete results were due in part to an enlarged interest which in turn can be traced to more effective methods of reaching farm owners. A much greater desire on the farms for improved forestry practices has sprung from realization that better wood practices contribute not only to meeting the farm timber needs but also to making the country home more livable and to the family income.

The work embraced such major projects as planting, improvement, cutting, timber estimating, fire prevention, and 4-H Club work in forestry. In several States marketing, sawmill improvement, and maple-syrup production were included. The most popular work was forest planting. It was extended in some form in all the 33 States and 2 Territories having extension foresters, and was the principal project in 5 mid-Western States, where windbreaks and shelter belts are needed on most farms. Forest planting is also the greatest farm forestry need in Hawaii and Porto Rico.

Better forestry practices were adopted on 21,350 farms. Of 8,400 forest plantations established, 3,088 were for windbreaks. There were 4,870 woods-management or thinning projects and 949 projects for controlling white-pine blister rust. Forestry projects were completed by 3,852 4-H Club members, mostly boys. There were 3 forestry clubs, with 5,608 members, an increase of 39 per cent over the enrollment in the preceding year.

NATIONAL-FOREST ADMINISTRATION

The expenditures for national-forest administration, protection, improvement, reforestation, and extension are shown in detail on page 79, totaling \$23,435,272.95. This is exclusive of expenditures for administration of the Forest Service as a whole (i. e., general overhead).

The appropriations of Federal funds for the national-forest enterprise in the fiscal years 1929, 1930, and 1931 are shown in Table 4.

TABLE 4.—*Appropriations of Federal funds for the national-forest enterprise, 1929-1931*

Item	1929	1930	1931
General expenses of administration, protection, and improvement.....	\$7, 119, 673. 00	\$7, 527, 730. 00	\$7, 477, 230. 00
Specifically for—			
Fire control.....	1, 269, 996. 57	3, 450, 000. 00	150, 000. 00
Improvements, tree planting, land and resource surveys, and land adjustments.....	1, 005, 270. 00	1, 101, 050. 00	2, 955, 500. 00
Land acquisition.....	1, 005, 156. 60	2, 000, 000. 00	2, 000, 000. 00
Roads and trails (construction and maintenance) needed primarily for forest protection and development.....	3, 540, 511. 91	3, 625, 855. 89	3, 671, 023. 72
Highway construction and maintenance primarily to meet public needs, as a recognition of Federal responsibility created by ownership of untaxed lands.....	4, 500, 000. 00	4, 500, 000. 00	8, 000, 000. 00

The amounts shown in Table 4 for the first and third items of the 1930 column are greater than was reported last year, in consequence of augmenting appropriations. Two deficiency appropriations increased the first item by \$332,500, of which \$177,500 was for insect control and \$155,000 for emergency guards. The third item gained \$35,000 through a special appropriation for the improvement of the Oregon Caves on the Siskiyou National Forest.

The appropriations for the fiscal year 1931 under the same two items (the first and third) differed from those for 1930 in the following respects: On the one hand, the above-mentioned special appropriations for 1930 drop out. On the other hand, increases were made under both items for various purposes. Under the first item, increases totaling \$282,000 comprised \$188,500 for the employment of additional forest guards and the purchase of fire-control equipment; \$20,500 more for the administration of timber sales; \$25,000 for the control of tree-destroying insects and \$25,000 for the control of the white-pine blister rust; \$3,000 for the removal of trespassing horses on national-forest ranges; and \$20,000 for the administration of new purchase areas. Under the third item increases totaling \$1,889,450 comprised \$1,500,000 for the construction of protection roads and trails, \$331,000 for other protection improvements (including \$25,000 specifically for expenditure in the four southern California forests), \$15,000 for range improvements, \$9,000 for administrative improvements, \$7,000 for camp-ground improvements, \$5,000 for planting, and \$12,450 for timber surveys and grazing reconnaissance.

The fire-control appropriation for 1931 shown in Table 4 is the regular appropriation for fighting forest fires and for aerial fire control, which is the same as in 1930, whereas deficiency appropriations made in 1929 and 1930 are added to the regular appropriation for those years. Since the expenditures that will have to be made for fire suppression are unpredictable and vary greatly, Congress does not attempt to provide adequate funds in advance but supplements a small regular appropriation by deficiency appropriations after the work is done.

The amounts shown as appropriated under the two road items for the individual years do not include balances brought forward or which may be carried forward from appropriations of previous years. The sums actually available for expenditure in any year

often vary widely from the appropriations for the same year through carry-overs of unexpended portions of earlier appropriations.

THE NATIONAL-FOREST REGIONS

Ever since 1908 the western national forests have been divided, for administrative purposes, into six districts, each under a district forester. Subsequently there were added, as need arose, the Eastern district, the Alaska district, and, finally, on January 1, 1929, the Lakes States district. The wisdom of this form of organization made itself evident from the outset, and its value has grown with the years. There has been, on the whole, a steady outward movement of responsibilities from the Washington office to the district office through a broader delegation of authority, as the district foresters with their staffs, have proved their competence to assume weightier responsibilities.

The Forest Service has always had the determined purpose not to centralize, but, on the contrary, to give local officers as much opportunity to use initiative and exercise discretion as is reconcilable and consistent with safety and coordination. The district foresters have provided indispensable halfway stations between the individual forest organizations and the central executive authority, receiving general direction in policy matters, expert advice and assistance of the highest quality on their more serious technical problems, and supervision, exercised principally through field scrutiny of their administrative performance by the Forester and his staff. Only in matters of very exceptional importance, either because of the magnitude of the transaction involved or because a question of new policy or policy interpretation is raised, is reference to Washington for decision necessary. The district foresters in turn have pressed further outward the exercise of initial responsibility as the forest supervisors have established their capacity to handle their local business and resources skillfully.

On May 1, 1929, the Secretary of Agriculture approved a change in the official designation of the nine districts, the district foresters and other district officers of the Forest Service, by which region and regional supersede the term "district."

On March 1, 1930, C. J. Buck became regional forester for the sixth region, the previous incumbent, C. M. Granger, having been made head economist and director of the forest survey. The nine regions and regional foresters are:

Region 1: Northern Region. Montana, northeastern Washington, northern Idaho, northwestern South Dakota. Evan W. Keller, regional forester in charge.

Region 2: Rocky Mountain Region. Colorado, most of Wyoming, South Dakota, Nebraska, western Oklahoma. Allen S. Peterson, regional forester in charge.

Region 3: Southwestern Region. New Mexico, most of Arizona. Frank C. W. Pooler, regional forester in charge.

Region 4: Intermountain Region. Utah, southern Idaho, most Nevada, northwestern Arizona, western Wyoming. R. H. Rutledge, regional forester in charge.

Region 5: California Region. California, southwestern Nevada. S. B. Show, regional forester in charge.

Region 6: North Pacific Region. Oregon, most of Washington. J. J. Buck, regional forester in charge.

Region 7: Eastern Region. Maine, New Hampshire, Vermont, Pennsylvania; all States south of the Potomac and Ohio and east of the Mississippi; Arkansas, Louisiana. J. C. Kircher, regional forester in charge.

Region 8: Alaska Region. Alaska. Charles H. Flory, regional forester in charge.

Region 9: Lake States Region. Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri. Earl W. Tinker, regional forester in charge.

THE NATIONAL-FOREST PROPERTIES

The gross area of the national forests on June 30, 1930, was 183,75,930 acres, of which 23,885,113 acres was in ownerships other than that of the United States, making the net area 160,090,817 acres. During the year the gross area decreased 589,023 acres, but the net increased 340,297 acres.

Area recomputations, based on better surveys and land data, reduced the gross area by 25,378 acres. Otherwise the gross area changes were as listed in Table 5.

TABLE 5.—*Additions to and eliminations from the gross area of the national forests made by acts of Congress, presidential proclamations, Executive orders, State land exchanges, other land exchanges, and departmental action under the act of March 1, 1911*

National forest	State	Additions	Eliminations
		<i>Acres</i>	<i>Acres</i>
Arapaho	Colorado	¹ 640	
Ashley	Utah-Wyoming	² 13,785	
Chittenden	Montana	¹ 160	
Black Hills	South Dakota-Wyoming	¹ 320	
Do	do	² 1,280	
Colorado	Arizona		³ 32,635
Cater	Oregon	¹ 1,317	
Custer	Montana-South Dakota	² 1,066	
Deschutes	Oregon	¹ 25,210	
Dislake	Utah	³ 13,578	
Freemont	Oregon	⁴ 193,199	
Harney	South Dakota	¹ 149	
Do	do	² 1,347	
Helena	Montana	⁴ 800	
Isatchie	Louisiana	⁵ 9,613	
John	Montana	¹ 3,568	
Mount Hood	Oregon	¹ 3,382	
Antahala	Georgia, North Carolina, Tennessee	² 122,966	
Olympic	Washington		⁶ 45,809
Seah	North Carolina-Tennessee		² 586,284
umas	California	¹ 1,081	
Butt	Colorado		² 401
uslaw	Oregon		⁶ 43,388
Joqualmie	Washington		⁶ 1,902
Sanislaus	California	¹ 1,646	² 7,726
Shoe	do	¹ 299	
ongass	Alaska		³ 168
Isayan	Arizona		⁴ 115,500
allowa	Oregon	¹ 2,199	
enatchee	Washington	¹ 1,798	
White Mountain	Maine-New Hampshire		² 130,912
Hitman	Oregon	¹ 1,677	
Total		401,080	964,725

Made under land exchange laws.

Made by presidential proclamation.

Made by Executive order.

Made by acts of Congress.

Departmental action under act of Mar. 1, 1911. (36 Stat. 961.)

Made by State land exchange.

The area eliminated from the Coronado National Forest is a part of the Fort Huachuca Military Reservation, which proved to be impracticable of administration as a national forest. The elimination from the Stanislaus National Forest was added to the Yosemite National Park, and that from the Tusayan National Forest was added to the Navajo Indian Reservation. The eliminations from the Pisgah and White Mountain National Forests were of lands found to be nonpurchasable under the acquisition laws, while the eliminations from the Olympic, Siuslaw, and Snoqualmie Forests were to permit selections by the States under land-exchange agreements. A number of small areas developed under special-use permits were eliminated from the Tongass Forest to permit their entry under the trades and manufacturing act as amended.

As the result of several laws permitting the acquisition of land outside of national-forest boundaries through exchanges, 43,446 acres were added. Public-land additions by acts of Congress, Executive order, or presidential proclamation totaled 225,055 acres, and additions to eastern national forests of lands believed to be purchasable under the Weeks and Clarke-McNary laws aggregated 132,579 acres of which, however, all but 9,613 acres must be acquired by purchase before possessing actual national-forest status.

In June the chairman of the Commission on the Conservation and Administration of the Public Domain requested the Forest Service to obtain and furnish to the commission data on public-domain land believed to be chiefly valuable for timber production or stream-flow protection. At the close of the year this work was well under way.

LAND ACQUISITION THROUGH EXCHANGE

During the year the State of Michigan conveyed to the United States 14,420 acres of land situated within national-forest boundaries receiving in exchange 14,393 acres of public land within existing or proposed State forests. A further exchange with the same State involving approximately 75,000 acres on both sides is under way. Progress was made in working out a further exchange with the State of South Dakota. In Colorado a national-forest area of approximately 80,000 acres suitable for administration as a State forest was designated and in process of appraisal at the close of the year, with a view to its exchange for an equal area of scattered State holdings in the forests. An exchange with the State of New Mexico still awaits a necessary constitutional amendment. The earlier exchanges with the States of Washington, Oregon, California, Idaho, and Montana gradually are being completed as selection lists are filed and approved.

Several bills to extend the provisions of the general exchange act to lands outside the national forests were introduced in Congress, but none was enacted and no new land-exchange legislation took place. During the calendar year 1929 reconveyance to the United States of 240,732 acres of private lands in exchange for 50,156 acres of national-forest land and \$643,837 worth of stumpage added a net 190,576 acres to the forests. The Secretary of Agriculture approved and referred to the Secretary of the Interior for further action 164 new cases, offering 237,356 acres of privately owned land in exchange for 117,416 acres of national-forest land and 114,829,000 board feet of national-forest stumpage. In all, t

December 31, 1929, 535 land-exchange cases have been consummated. They have brought the United States 780,452 acres of land, valued at \$3,312,983, in exchange for 236,146 acres of national-forest land, valued at \$1,289,088, and 587,587,000 board feet of national-forest stumpage, valued at \$1,664,515. Besides the net gain of 544,306 acres in national-forest area the volume of stumpage on the acquired lands is much greater than that surrendered. A much larger land-exchange business could have been done were it not for the fact that to avoid undue impairment of county incomes through lessened timber-sale receipts, of which 25 per cent goes to the counties, the value of stumpage employed for land-exchange purposes is usually not allowed to exceed 10 per cent of the receipts from timber sales.

Table 6 shows the progress and results of the land-exchange work to the close of the calendar year 1929.

TABLE 6.—*Land exchanges consummated to December 31, 1929*

State	Number	Land conveyed to the United States		Selected land granted in exchange		Timber granted in exchange	
		Acres	Appraised value	Acres	Appraised value	Volume (thousand board feet)	Value
Arizona.....	18	130,691	\$233,168	8,342	\$15,906	79,336	\$198,611
Arkansas.....	2	27,288	47,089			5,752	46,020
California.....	57	106,249	1,020,045	10,333	316,726	142,604	504,373
Colorado.....	106	52,026	209,798	14,620	48,119	48,468	143,195
Florida.....	12	56,106	117,175	21,095	42,696	12,514	72,785
Iaho.....	48	41,656	125,091	10,621	51,499	8,281	54,351
Michigan.....	5	45,781	48,004	45,337	47,632		
Minnesota.....	12	1,829	9,887	26	16	1,386	6,113
Montana.....	58	84,971	170,243	44,452	104,321	19,809	57,404
Nebraska.....	1	8,960	44,800	8,959	44,793		
New Mexico.....	24	48,083	236,583	7,644	10,548	92,934	217,424
Oregon.....	126	113,445	820,089	41,420	504,645	135,561	266,046
South Dakota.....	10	2,662	12,787	420	640	2,807	9,641
Utah.....	23	17,710	105,920	17,837	97,667		
Washington.....	29	40,197	106,335			37,942	87,949
Wyoming.....	4	2,798	5,969	5,040	3,880	193	603
Total.....	535	780,452	3,312,983	236,146	1,289,088	587,587	1,664,515

Logging operations on private lands near or within the national forests are progressively extending the area of cut-over land. Much of it is beginning to revert to the counties or States, which are poorly prepared to assume the costs of its protection and regeneration. Many owners of heavily timbered lands have begun to doubt the feasibility of carrying their properties until the stumpage is in demand, and some are showing interest in the provisions of section 7 of the act of June 7, 1924, which authorizes the United States to accept donations of forest lands subject to the reservation of stumpage or other rights. Exchanges afford one means of bringing under Federal ownership and administration lands which would otherwise partly or wholly lose their productive value. Frequently adding such lands to the national forests markedly enhances the value of the latter through facilitating their protection and management, bringing slash hazards under control, and enlarging the control of erosion and floods. But in comparison with what needs to be done, the present exchange policy is of very inadequate scope.

The national forests contain almost 24,000,000 acres of State and private lands. Some 12,000,000 to 14,000,000 acres of these lands and several million acres of contiguous outside lands eventually should be under national-forest administration, since the private owners are not likely to assume the cost or responsibility of maintaining the forest or watershed values of these lands, the States presumably will not wish to do so, and the integral relationship of the lands to the national forests makes it possible to administer and protect them more effectively and economically as parts of the forests than in any other way. If those parts of the unreserved and unappropriated public domain unquestionably adapted to private management could be employed for land-exchange purposes under appropriate legislative authority, the fundamental purpose of existing land laws could be greatly furthered without any drain upon public funds.

LAND ACQUISITION THROUGH PURCHASE

Title was taken under the Weeks law, as amended by the Clark McNary law, to 417,064 acres, at a cost of \$1,512,181.22. Purchases totaling 507,922 acres and creating a total obligation of \$1,430,668.87 were approved by the National Forest Reservation Commission during the year. The average price of \$2.82 per acre for the lands approved for purchase and of \$3.63 for the lands actually acquired compares with a previous average of \$5.11 for all lands acquired. At the close of the year the average cost of all lands fully acquired not including overhead, was \$4.93 per acre, the total \$16,818,602.00 and the area 3,413,293 acres distributed by States as shown in Table 7.

TABLE 7.—*Acreage of timberland acquired in the fiscal year 1930, and total acquired to July 1, 1930, by States*

State	Acquired in 1930	Average price per acre, 1930	Acquired up to July 1, 1930	State	Acquired in 1930	Average price per acre, 1930	Acquired up to July 1, 1930
	<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>		<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>
Alabama.....	7,929	5.20	104,670	North Carolina....	8,062	4.21	378,
Arkansas.....	99,914	4.15	246,294	Pennsylvania.....	25,997	4.60	317,
Florida.....	85,015	5.00	85,015	South Carolina....	1,113	6.07	43,
Georgia.....	10,047	5.49	254,999	Tennessee.....	3,900	4.30	376,
Louisiana.....	9,613	3.25	9,613	Virginia.....	6,996	4.50	595,
Maine.....	121	5.75	33,482	West Virginia.....	35,404	3.96	278,
Michigan.....	71,627	1.65	144,727	Wisconsin.....	15,606	1.28	15,
Minnesota.....	35,440	1.55	67,579				
New Hampshire...	280	6.89	460,753	Total.....	417,064	3.63	3,413,

Approval by the National Forest Reservation Commission, May 1, 1930, of four new purchase units initiated forest acquisition in three new States. The units are the Cumberland in Kentucky, the Homochitto in Mississippi, the Kiamichi in Oklahoma (and to a small extent in Arkansas), and the Evangeline in Louisiana.

The Cumberland unit is typical of the hardwood forests of Kentucky, and it embraces important parts of the watersheds of the Kentucky, Licking, and Cumberland Rivers, which, through the Ohio, belong to the Mississippi system. The Homochitto is representative of a very productive forest region and comprises parts of the watersheds of the lower Mississippi. The Kiamichi is 90 per cent

shortleaf pine forest and includes portions of the watersheds of the Canadian and Porteau Rivers, which drain through the Arkansas, Kiamichi, and Little Rivers into the Red River. Timber production is the primary purpose of the Evangeline unit, which consists of excellent longleaf, loblolly, and hardwood soils, from which large quantities of timber have been removed. It drains into the Atchafalaya and Red Rivers.

Adjustments by the commission of boundaries of existing purchase units eliminated 14,546 acres of nonpurchaseable land from the Huron unit and 28,800 acres from the Marquette unit; added to the Keweenaw unit 91,520 acres and to the Superior 59,445 acres; and eliminated from the White Mountain unit an area of 130,912 acres within which no purchases had been made, offsetting the establishment of the Green Mountain unit in Vermont.

By the passage of the act of June 2, 1930, authorizing acquisition appropriations of not to exceed \$3,000,000 annually for the fiscal years 1932 and 1933, Congress established a new fiscal program and policy for carrying out the provisions of the Weeks law and the amendatory section of the Clarke-McNary law. While neither law prescribes any geographic restrictions upon land purchases, all considerations of public interest have joined to confine the field of purchases under these laws to the country east of the Great Plains. Here are found the major part both of our population and of our national timber consumption, the most numerous and important navigable streams, and the major part of our forest land, of which only an insignificant fraction is under permanent public management. It is within the eastern half of the United States that the forest problems of largest proportions, most acute, and of most vital social and economic consequence. For these reasons the scope of the Federal program of forest-land purchases east of the one hundredth meridian is of deep public concern.

As population increases the rôle of water becomes increasingly important. It is indispensable to life, a source of power, a means of transportation, a contributor to recreation, beauty, the food supply. Inseparably related to water in our forest economy is timber, the basis of huge industries, the chief foundation of the economic life of wide regions, the dominant element in the existence of thousands of communities. The measures hitherto adopted to conserve these vital natural resources in the eastern United States are extremely inadequate.

Through the curtailment of the area used for farm-crop production, the area for which timber production is the highest economic use is increasing. An unofficial estimate compiled in 1929 with the cooperation of the State foresters places the amount of forest land east of the Great Plains at 375,707,000 acres, of which 6,319,494 acres, or 1.7 per cent, is in national forests, and 4,743,838 acres, or 1.3 per cent, in organized State forests. Other publicly owned lands, apparently inclusive of some unreserved public domain, total 4,638,902 acres, or 1.2 per cent. Thus only 4.2 per cent of the estimated total is in public ownership, and not all of that small fraction is receiving proper care. An inquiry conducted by the Society of American Foresters in 1929 led to the conclusion that only 8,587,000 acres, or 2.4 per cent, of the remaining 360,000,000 acres in private ownership is under acceptable silvicultural management.

Such a situation challenges national attention. As seen by the several State foresters, the expansion of State forests affords the prospect of a total of 11,959,000 acres within the next 10 years, and of ultimately 36,665,925 acres. Unless private forestry develops far beyond any present promise, Federal forest expansion will be imperative. The National Forest Reservation Commission has approved a program of increased Federal acquisition in the East which contemplates the purchase of approximately 9,713,000 acres. This would bring the eastern national forests up to approximately 16,032,000 acres. The fruition of this program should be accelerated rapidly as the national finances will allow. Each passing year adds to the difficulties of assembling units susceptible of the most efficient and economical administration and probably will add to the cost. Meanwhile there is need for establishment by Congress of a long-term fiscal policy and plan under which orderly and systematic progress can be made and definite programs formulated with assurance that the work can be carried out with the greatest economy and effectiveness.

SPECIAL USES

These embrace all uses of national-forest lands or resources other than timber, forage, and occupancy rights established under the general land laws or under permits issued by the Federal Power Commission. The adaptability of the national-forest lands to a wide variety of commercial, industrial, and recreational uses is recognized by the Forest Service in its management plans, and all proper forms of occupancy and use are authorized by permit. Uses of a public character or required to facilitate the use of other forest lands and resources are granted free; those of a commercial or exclusive character, at reasonable annual fees. A steady increase in this form of national-forest use is tied in with the growth and prosperity of many dependent localities whose commercial and industrial progress depends upon the fullest sound utilization of natural resources. Under present laws 5 acres is the largest area for which a permit can be issued for a definite term of years under conditions affording the security of tenure requisite to justify a substantial investment. This area limitation militates against development and should be modified to allow the issuance of term permits for areas up to 160 acres, at the discretion of the Secretary of Agriculture.

At the close of the calendar year 1929, 34,200 special-use permits were in effect, of which 15,959 were free and 18,241 involved annual rental charge. The free permits increased by 191, the paid permits by 686. Receipts totaled \$300,257.30, an increase of \$13,138.22.

CLAIMS AND SETTLEMENT

Of reports on homestead claims, 132 were favorable and 23 unfavorable, the latter because of failure to meet the residential and cultivation requirements of the public land laws. Almost all of the homestead claims now requiring consideration have been initiated under the forest homestead law, and since all lands chiefly valuable for agricultural purposes have now been listed a progressive decrease in this class of cases is inevitable.

Of reports on mineral claims, 102 were favorable and 29 unfavorable. As in preceding years, fraudulent mining locations seeking title to lands chiefly valuable for other purposes imposed a heavy burden upon the Forest Service, partly through conflicts with the best use and development of the national forests and partly through the expenditure of time and money in their examination and the ensuing contests. The fact that title to public properties worth in some cases as much as \$2,500 per acre can be established under the mining laws if negligible indications of mineral exist, through superficial and perfunctory expenditures upon alleged development work, creates a situation which militates against the public interest. Abuses of the mining laws are not by miners but by speculators whose object is not to destroy large existing values by mineral development but to appropriate these values. There is urgent need for amendment of the mining laws to stop these gross abuses.

COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

Four bills authorizing the President, upon joint recommendation of the Secretaries of Agriculture and the Interior, to transfer lands from national forests to national parks were enacted by Congress during the year. The act of May 7, 1930, related to the Yosemite Park; that of June 21, 1930, to the Rocky Mountain Park; that of June 12, 1930, to the Bryce Canyon Park; and that of July 3, 1930, to the Lassen Volcanic Park. Under authority of a previous act 7,726 acres were transferred from the Stanislaus National Forest to the Yosemite National Park by proclamation of April 14, 1930. At the close of the year steps were being taken to accomplish the transfers authorized.

Other proposed transfers of lands from national forests to national parks are receiving consideration. They involve the Kings River Canyon, now a part of the Sequoia National Forest in California; lands in the Sierra National Forest, Calif., to the east of the Yosemite Park; lands in the Rainier National Forest, Wash., to the east of the Rainier National Park; lands in the Teton National Forest, Wyo., to the east and south of the Yellowstone Park; and lands in the Santa Fe National Forest, N. Mex., tentatively suggested for establishment as the Cliff Cities National Park. None of these proposed transfers has been referred to or considered by the coordinating committee on national parks or forests, but certain changes in the east and south boundaries of the Yellowstone Park were studied in the field during July, 1929, by a special committee appointed by the President under authority of Congress.

ADJUDICATION OF NORTHERN PACIFIC LAND-GRANT CLAIMS

Preparations for the filing by the United States of the suit for the adjudication of the rights of the Northern Pacific Railway Co. under its land grants, as authorized by the act of Congress approved June 25, 1929, were approaching completion at the close of the year, and shortly thereafter suit was filed for hearing in the eastern judicial district in the State of Washington. Because of the important public interests and monetary values involved, this suit probably will rank as an outstanding case of its kind.

PROTECTION FROM FIRE

The number, size, and causes of fires on the national forests in the calendar year 1929, as compared with those of the previous year and the average of the past 5-year period, are shown in Table 8.

TABLE 8.—Comparison of fires on national forests, calendar years 1929, 1928, and 5-year average, 1925–1929

	Number of fires			Percentage of total		
	1929	1928	Average, 1925–1929	1929	1928	Average, 1925–1929
Class:						
Burns of 0.25 acre or less.....	4, 105	3, 873	3, 937	55. 11	55. 96	55. 11
Burns between 0.25 and 10 acres.....	2, 040	1, 914	1, 941	27. 39	27. 66	27. 39
Burns of 10 acres and over.....	1, 304	1, 134	1, 206	17. 50	16. 38	17. 50
Total.....	7, 449	6, 921	7, 084	100. 00	100. 00	100. 00
Cause:						
Railroads.....	290	281	306	3. 89	4. 06	4. 06
Lightning.....	3, 499	3, 195	3, 631	46. 97	46. 17	51. 11
Incendiarism.....	786	690	686	10. 55	9. 97	9. 97
Débris burning.....	305	230	234	4. 10	3. 32	3. 32
Lumbering.....	123	133	120	1. 65	1. 92	1. 92
Camp fires.....	702	717	670	9. 43	10. 36	9. 43
Smokers.....	1, 429	1, 345	1, 155	19. 18	19. 43	16. 38
Miscellaneous.....	315	330	282	4. 23	4. 77	3. 32
Total.....	7, 449	6, 921	7, 084	100. 00	100. 00	100. 00

Calendar year	Total area of national-forest land burned over	Total damage of national-forest land burned over	Total cost of fighting fires, exclusive of time of forest officers
1929.....	<i>Acres</i> 799, 082	<i>Dollars</i> 4, 338, 755	<i>Dollars</i> 3, 203, 100
1928.....	398, 900	833, 122	1, 193, 000
5-year average, 1925–1929.....	479, 225	2, 157, 308	1, 613, 000

Last year's report called attention to the declining percentage of the total area within the forests that has been burned over annually, as shown by the record of 5-year averages from 1910 to 1928. It was pointed out, however, that the rate of decline was tending to slow up, and that with the 1929 record added to complete the showing for the last five years this apparent slowness of recent progress might be emphasized. In reality the heavy losses that came late in the calendar year changed the apparent direction of the trend. The percentage of the gross area of the national forests burned over annually, by 5-year averages, 1910–1929, has been:

	Per cent
1910–1914, inclusive.....	0. 1
1915–1919, inclusive.....	0. 1
1920–1924, inclusive.....	0. 1
1925–1929, inclusive.....	0. 1

This apparent reversal of the earlier progress in fire control is due to the phenomenon of the "bad year." The great bulk of the loss occurs in seasons of extreme weather conditions that enormously increase the difficulties both of fire prevention and of fire suppression. Each 5-year period from 1910 to 1924 included one such season.

whereas the 1925-1929 period included three. The result was to overbalance the gains made in preparedness and technical skill. The necessity of financing, organizing, and managing forest-fire activities on a basis of preparedness for the weather conditions encountered in the bad year is becoming more and more plain.

THE PROTECTION PROBLEM OF 1929

In severity the 1929 fire season can be compared only with the seasons of 1910 and 1919. On the whole, the conditions in 1929 are believed to have been more unfavorable than in either of the two previous record bad years. The three Pacific coast States, northern Idaho, and western Montana presented the outstanding protective problems.

The season opened promisingly and did not become abnormally severe until the latter part of the summer. In California, for example, the expenditures during the summer months were much lower than in 1928. But in 1928 the fire season was practically over by the middle of October, while in 1929 the worst of the season followed, with large fires in the last two weeks of the month and throughout November and with fires burning harder than they normally do in midsummer. On all forests in the Sierra Nevada country the fire season continued up to December 8, and on the forests in southern California up to the middle of January.

In the North Pacific States lightning storms caused serious fires in a period of extreme inflammability the latter part of July. By the middle of August 13 large fires out of control had burned over 35,000 acres of national-forest land in Washington and Oregon. Five or six years of severe drought had already passed in this region, and in 1929 only about half as much precipitation fell as the average for the five years preceding. June was the only month with any rain between May and October, and the quantity was not sufficient to have material influence. The prolonged drought had a cumulative effect on the forests, causing a decided loss of vigor, less lush plant growth, less moisture content in the tree foliage, utter dryness in the forest floor, and debilitation of the timber so that there was less resistance to and greater death from insect and fungus enemies. Consequently there had been a building up of inflammable material which enabled fires to spread more quickly and burn more intensely than they normally would.

In eastern Washington an electrical storm on August 2 started some 81 fires on three adjoining forests. Immediately after this storm there were several days of unusually low humidity and high wind. A single fire spread over some 7,000 or 8,000 acres in about three hours. With a number of large fires out of control, on August 11 came one of the worst fire days in the history of organized protection in the region. The humidity was extremely low, and the wind blew almost a gale. On the three forests, fires covered extensive areas. August 27 to 30 was another period of acute burning conditions, but except for one fire, which made a large additional spread, the fires in the region had been adequately controlled prior to that date and did not again escape.

Early in August, 1927, a similar electrical storm started an even greater number of fires on these three forests, but the losses and sup-

pression costs were relatively light. In 1929 the electrical storm was immediately followed by extremely bad fire weather; in 1927 control was facilitated by reasonably favorable weather. In 1929 the forest cover and humus were so parched that the smallest spark, carried by the wind a quarter of a mile or more from the edge of a controlled fire and falling in unburned material, would start a new fire which would at once spread rapidly. It was the unanimous opinion of the men handling the fires that never had they known them to burn so hard or spread so fast.

The large fires in eastern Washington were placed under control early in September, and more favorable weather followed. But the critical conditions transferred themselves to western Washington and Oregon. A heavy smoke blanket made detection and suppression extremely difficult. On September 12, 20 of the 22 forests in this district were closed to all forms of use except travel over regularly used roads and camping at established camp grounds. The Governor of Oregon postponed the opening of the hunting season. From September 10 to September 20 conditions reached their peak. A logging fire on the Mount Hood Forest burned over 40,000 acres and seriously threatened the town of Estacada. Another fire, starting outside the Columbia Forest, swept inside and in two days burned over 30,000 acres. Other large fires occurred elsewhere. Although on September 21 light showers, lower temperature, and high humidity relieved the situation somewhat, numerous fires started during the next three weeks, but few attained large size, and the fire season was apparently ended on October 9 by general rains. Late in November, however, large fires occurred in southern Oregon and continued throughout the month, while critical conditions lasted well into December. Normally the fire season closes in Washington and Oregon by September 10, except in southern Oregon, where September 30 is the recognized closing of the season.

Approximately one-half of the total fire-fighting expenditure during the fiscal year was in Montana and northern Idaho. In the region from August, 1928, to October, 1929, the precipitation was only 57 per cent of normal. Precipitation at the Weather Bureau station at Spokane, Wash., during 99 days following June 15, 1929, was but 0.11 inch. So great a deficit in rainfall necessarily brings acute fire conditions. An abnormally large number of fires had to be handled by a protection organization adequate only for a normal season. As in other dry years, large numbers of lightning fires started simultaneously. On the Clearwater Forest a storm on July 15 started 60 fires; on the St. Joe Forest 30 were started on July 1 and 27 on August 29; the Blackfeet had 35 fires started from a storm on August 8; the Kootenai had 27 fires started on August 1 and 41 on August 30. In early August extreme inflammability prevailed, and in the second and third weeks of the month the situation rapidly grew worse. August 23 was one of the worst fire days in the history of the region, rivaling the disastrous August 22 and 23 of 1910. Heavy gales caused the fires to run rapidly over great areas. A fire starting near Kalispell, Mont., on protective association land outside the national forests covered on August 23 approximately 75,000 acres of national forest, national park, and private land, with extensive losses of improvements and property and irreparable

damage to choice portions of the Glacier National Park. At one time during the period from August 20 to August 31, 5,500 men were employed in fighting fires.

In this region normally general rain can be expected the first week in September. In the summer of 1929 none occurred until November 1. From September 1 to 10 the daily expenditure was \$40,000. During the rest of September scattered showers and longer nights relieved the situation to a marked degree, but fires occurred throughout October. Light general rains then definitely closed the fire season, at least 45 days later than usual.

The unprecedentedly prolonged season made necessary unusually large expenditures for mopping-up work. In previous years storms have aided in extinguishing fires or have put them out entirely. Last year no big fire was extinguished by rain.

The history of the Salmon River fire, on the Nezperce National Forest, illustrates the difficulties encountered. This lightning fire broke out on August 3, on the steep slope north of the Salmon River. To get to it the nearest man had to travel 8 miles without trail, with a 2,000-foot climb the last 3 miles. Starting immediately upon report of the fire, he reached it in a little less than three hours and found it had then covered approximately 25 acres. This man worked alone from 4 p. m. until 6 a. m. of August 4. In the meantime the fire spread considerably. At 4 a. m., August 4, a second man, dispatched on foot from the Salmon Mountain lookout nearly 20 miles away, after traveling partly over trails and partly through almost inaccessible country without trails, reached the scene. About 1 p. m. the ranger and his assistant arrived from the Deep Creek ranger station, more than 30 miles away, bringing food and some equipment. A trail crew of five men next reached the fire, between 4 and 5 p. m., having received word that morning by messenger and having traveled some 17 miles, partly by trails and partly through difficult country without trails. In spite of the efforts of the slowly assembling handful of men the fire, spreading rapidly on the steep, broken topography, finally reached large proportions. Before adequate reinforcements could be brought in it had spread to the Salmon River and along its north bank nearly 19 miles. It was finally brought under control by fire-fighting forces sent in from Missoula. The trip required three days and involved travel by road for 113 miles and walking over rough trails for from 36 to 46 miles. The fire covered about 20,000 acres, and its suppression cost approximately \$25,000.

In northern Minnesota a very serious fire situation developed early in July on the Superior National Forest, where the conditions generally were the worst in years. The Intermountain Region (Region 1) experienced the worst fire season since 1919, following bad general electrical storms on July 13. The season was considered the driest, hottest, and windiest of record in that region. Regions 2, 3, 7, and 8 had normal or below normal fire seasons.

The number of fatalities in the 1929 season was the greatest of any year except 1910.

The employees of the Forest Service whose lives were lost, so far as they are known, were Joe Aiken, Archie White, Lester Rudd, Tom Gorman, Norman K. Deem, Richard Gell, Douglas C. Ingram, Arnani St. Luise, J. F. Martin, William O. Makeiff, Fred E. Gibson,

Franz Frank, Robert Keys, Richard Cornett, Sam Swanson, and Paul Croxton. Men not on Forest Service pay roll at time of death were William A. Doelle, David Koontz, Philip Roe, C. S. Hutto, J. H. McCubbins, and Alvin Peoples.

SEASON OF 1930

The fire season of 1930 promises to stand in striking contrast with that of 1929. While the number of fires has been above the norm through the major part of the season, unusually few have been large. This is especially true in the Northern Region (Region 1), where 9 per cent of the 1,633 fires started up to September 10 were held below 10 acres in size. In the North Pacific Region (Region 6), likewise, an unusually large percentage of fires have been held to small areas.

The spring season in all the western national-forest regions was generally favorable. In the North Pacific Region fire conditions became critical during July, and several particularly bad and large fires occurred on the Deschutes Forest, in Oregon, but better weather relieved the situation. There has been more rainfall in the western national forests than there was in 1929. The number of lightning fires has been about normal, but the electrical storms have been more scattered both in location and in time. In the Eastern National Forest Region the 1930 season has been unusually severe, with fires during June, July, and August on almost all of the forests. A great many fires were started by lightning on the Ouachita and Ozark Forests, in Arkansas—an unusual thing in the eastern forests.

PROGRESS IN PROVIDING THE MECHANISM OF PROTECTION

The quarter century since the Forest Service was created, February 1, 1905, by absorption of the old forest reserve organization into the Bureau of Forestry of the Department of Agriculture, has brought vast changes in the organization and methods that are employed in protecting the forests.

The field force in the first years was predominantly nontechnical; the forests were mainly unmapped wilderness solitudes; the methods and procedures were primitive. There was virtually no equipment, no experience, no precedent. Each supervisor and ranger had to meet emergencies as they arose, barehanded and unadvised. The changes that most strikingly set apart the protective organization and effort of the present day from that of the first five years are the result of a persistent struggle for better ways, better knowledge, and better accomplishment. Protection has continuously absorbed the major effort of the Forest Service and has accounted for the major part of the outlay upon the forests. It has progressed from a primitive, unorganized, catch-as-catch-can sort of struggle of untrained men against novel conditions into a highly developed technical branch of forest administration, with definite objectives and growing precision of attack at crucial points.

The forest-fire problem in the United States is unique. A combination of climatic conditions and human habits have created difficulties of forest-fire control such as no other country has had to meet. In their efforts to develop an adequate system of control American foresters have received practically no aid from the experience or literature of other countries. The difficulty of pioneering in this

field has been greatly increased by an unfavorable weather cycle and by rapidly increasing human use of the forests. In 1929 the length and severity of the usual period of summer drought in several regions surpassed all records since the creation of the national forests.

Yet in contrast with 1905, when destructive fires burned practically everywhere in the national forests without effective restraint, well over half the forests are now receiving a degree of protection that holds under one-tenth of 1 per cent the area annually burned over. Twenty-five years ago there was no detection system, with manned lookout stations on towers and mountain peaks, and connecting telephone lines. During the present season 1,473 watchmen with assigned stations on mountain peaks or towers served as the eyes of the fire-control organization. They used 451 towers and 950 structures erected for their shelter at their posts of duty. Of telephone line constructed and used for protection there was 37,148 miles.

In 1905 the number of rangers and guards employed was 466, 1 man to every 184,232 acres. In the summer of 1930, 3,676 men were employed as rangers and guards, or 1 to every 50,048 acres. In addition, from 5,000 to 8,000 men were employed on road, trail, or other work on the forests where they could be drawn upon for fire fighting or other fire duty, and nearly half of these men were given special fire training. If necessary, as many as 1,000 of these road and trail workers can be thrown into special positions in the protective organization as emergency lookout men, patrolmen, or firemen for any period of acute danger.

Formerly local residents took no regular part in the detection and suppression of forest fires, public sentiment usually ranging from indifference to a belief that forest fires were beneficial if no personal property was destroyed. At present the number of local residents with whom definite arrangements have been made to take part in detecting and suppressing fires probably exceeds 20,000. On or near many of the 733 ranger districts there is a considerable population, and in some instances several thousand persons are prepared to take part in fire fighting when needed. It is common for organized crews of cooperators to reach and suppress fires before forest officers arrive.

It is only in rather recent years that the necessity for personnel management as a means to successful fire control has been definitely recognized. No amount of money and equipment can accomplish fire control without good human engineering. The training of co-operators, improvement workers, fire guards, and all fire executives, while still in the development stage, is recognized as indispensable if men are to give a good account of themselves when the times of perplexity and stress come.

Important technical developments in forest-fire control concern such matters as determination of the complex of weather conditions constituting "fire weather," so that it is rapidly becoming possible for a forest officer to know when the degree of fire danger necessitates closing down logging operations to avoid unjustifiable risks of disaster. In the investigation of criminal violations of State and Federal fire laws forest officers have been trained to combine the technique of professional criminal investigations with the elusive skills of woodcraft, since neither type of skill will serve without the other. A method has been developed for determining the combination of

number and location of fire guards and road and trail location and mileage which will afford the most effective protection at a given annual cost. A method has also been developed for determining the length of time within which fires in a given area must be reached if losses are to be kept within a given limit.

Approximately 15,500 miles of road have been constructed primarily for fire control, and a large additional mileage which has been constructed for other purposes contributes to the speed with which fires can be reached. These roads are supplemented by 47,000 miles of trails which have been built by the Forest Service, almost wholly to meet the needs of fire-control activities.

Mechanical aids to fire control, formerly limited to such familiar tools as the ax and shovel, now include a long list of tools, implements, instruments, and machines, of which some have been invented to serve specific fire needs, and some have been taken over from industrial uses. Among them are instruments for measuring the moisture content of the litter on the forest floor; hand tools of numerous types; radio equipment designed to operate under the adverse conditions prevailing in rough timbered country; airplanes, which while not as helpful as is popularly supposed, have been used for over 10 years and might have a revolutionary effect on some phases of fire control if certain experimental efforts of inventors prove effective; various types of graders and other digging tools drawn by heavy tractors, which facilitate the construction of low-cost protection roads, permanent fire breaks, and temporary fire lines; and portable pumps, tank trucks, and other means of putting water on forest fires.

PROTECTION FROM INSECTS AND TREE DISEASES

Timber crops, like others, are always subject to injury from insects. Old stands of coniferous trees, such as cover large areas of the western national forests, are specially exposed to attack by bark beetles. These are ordinarily present only in sufficient numbers to attack successfully individual weakened trees. Occasionally, however, vast hordes develop and kill immense quantities of old-growth timber unless combated effectively. Like fires, these epidemics should be fought while they are still small.

Studies by the Bureau of Entomology have shown that the best way to prevent losses from these bark beetles is to kill the developing broods in trees which have been attacked. The trees containing these broods are sure to die, although the foliage may not turn brown until after the insects have reached the adult stage and emerged to attack other trees. There is no feasible method of saving a tree which has been attacked by thousands of pairs of adult bark beetles. The cutting or destruction of an infested tree in order to kill the brood of beetles in or under its bark does not, therefore, add to the loss of timber, but is comparable to the necessary cutting of trees in clearing a line around a forest fire. If the circumstances make possible the use of the wood, so much the better; but if not, the loss has already been incurred and the cutting or burning of the tree stops its use by the beetles as a breeding place and destroys the new generation.

During the year epidemic infestations were fought in old timber in Idaho, Wyoming, Montana, Oregon, and Colorado. The largest

single project was on the Coeur d'Alene National Forest, in Idaho, where very valuable western white-pine stands were threatened by a rapidly increasing bark-beetle infestation. A total of 22,841 trees were felled and the bark was peeled from the infested portion of the stem, thus exposing the grubs of the new generation of beetles to the dry air and to attack by small rodents and ants. This work was done in less than three months and necessitated the employment of 400 temporary laborers. Similar but smaller infestations in western white-pine stands on the Clearwater Forest, in Idaho, and the Kootenai Forest, in Montana, were also treated. The protection of the valuable timber on these areas was made possible by a deficiency appropriation.

Work was continued in the stands of lodgepole pine on the national forests west and south of the Yellowstone National Park. The trees there are smaller than in the white-pine region and their bark is not so thick. It is therefore practicable to spray oil on the infested trunks, and, by setting fire at the base, to heat the bark sufficiently to kill the grubs without the expense of felling and peeling the trees. About 70,000 infested lodgepole-pine trees were so treated on the Targhee, Teton, Wyoming, Caribou, and Cache National Forests. These infestations were a serious threat not only to the extensive stands of susceptible timber on the national forests but to those on the near-by Yellowstone National Park as well. On the areas where treatment had been impossible in previous years the beetles which emerged in the summer of 1929 were sufficient in number to attack and kill an average of two and one-half new trees for each previous host tree.

In Oregon another species of the same genus of bark beetles was fought on the Fremont and Deschutes National Forests, in cooperation with the owners of intermingled or adjacent timberland. This beetle attacks slow-growing trees of western yellow pine, a thick-barked tree. It was necessary to fell the trees and to peel off and burn the infested bark, at the same time exercising great care to prevent the escape of the fires.

On the Colorado National Forest, work on a troublesome infestation in western yellow pine was done, on a small scale, for the fourth successive year, and it is believed that the epidemic has been stopped. In this case felling and peeling the infested trees was sufficient to kill the grubs. Sales of mature timber for the manufacture of ties have helped to control this infestation.

On the Shoshone National Forest, in Wyoming, the local control of the spruce bud worm was undertaken, on an experiment basis, in cooperation with the Bureau of Entomology. This insect, in its larval stage, eats the needles of spruces, true firs, and Douglas fir, and can be fought only by spraying the trees with poison. The results of this effort will not be known until the growing season of 1931.

During the year the effects of the introduction, by the Bureau of Entomology, of a parasite of the pine-tip moth on the Nebraska National Forest became apparent. At one time the serious checking of the growth of the western yellow pine, in the sand-hill region, by the tip moth made the wisdom of planting that tree seem doubtful. This doubt has now been removed, after several years of cooperative

study and effort. The losses from the tip moth have been reduced to insignificance in the areas to which the introduced parasites have spread.

The white-pine blister rust continued its rapid spread in Idaho and Oregon. This disease is so deadly to all of the white (5-needled) pines that its control is a prerequisite to the growing of timber crops of those valuable trees. Fortunately, part of its life cycle is in the leaves of currants and gooseberries, and destruction of those plants in the vicinity of the pines makes control possible. During the year strips around Forest Service nurseries in Montana and West Virginia were cleaned of bushes of these alternate hosts, to prevent the possibility of the infection of nursery stock. This was accomplished through the cooperation of the Bureau of Plant Industry, but funds were not available for the much larger job of destroying the wild currants and gooseberries on about 1,500,000 acres of white-pine producing land in northern Idaho, western Montana, and north-eastern Washington, where the largest values are now endangered. For the fiscal year 1931 a fund of \$25,000 was appropriated for beginning this protective task in cooperation with the Bureau of Plant Industry, but a much more rapid extension of the protected area will be necessary than can be effected with this annual amount if very serious losses are to be avoided in the western white-pine region. Furthermore, similar conditions are bound to develop in the sugar-pine region of California.

Surveys made during the year indicate that currants and gooseberries are not abundant on the eastern white-pine growing areas within the national forests in Virginia and North Carolina. The growing of this tree in this region will consequently not be hindered to the extent that had been feared. However, other species than white pine are being chiefly used in establishing plantations on the national forests in the Lake States and in Pennsylvania, partly because of the danger from this exotic rust.

TIMBER

More timber was cut on the national forests than in any previous year, and the receipts from sales were larger. The rate of increase however, was less than in 1929, because of the depression in the lumber industry in the spring of 1930, especially on the Pacific coast. Including the timber cut in fulfillment of land-exchange agreements there was cut in the fiscal year 1930 1,655,242,000 board feet, as against 1,502,001,000 board feet in the fiscal year 1929—an increase of about 10 per cent. Since the lumber production of the country was practically stationary in the calendar year 1929, and will apparently decrease sharply in 1930, the stability of the national-forest timber business is apparent.

During the 25 years since the Forest Service was organized the use of national-forest timber has grown vastly. Last year six national forests each cut more timber than was taken from all the national forests in 1905. The growth has not been even by fiscal years, some showing large gains and others small losses when compared to those just preceding. The general movement is illustrated by the following figures:

Timber cut on all national forests under sales and exchanges

Year	Board feet	Year	Board feet
1905-----	68, 000, 000	1920-----	806, 000, 000
1910-----	380, 000, 000	1925-----	1, 038, 000, 000
1915-----	566, 000, 000	1930-----	1, 655, 000, 000

As has been frequently emphasized in previous reports, this growth has not been brought about by crowding national-forest timber on the market and seeking the establishment of new large sawmills. It has been due in recent years primarily to purchases by established lumber companies which had exhausted their privately owned timber or were logging intermingled or adjacent holdings. Especially since 1920, the increased cut has gone chiefly to mills which needed it if they were to continue as industrial enterprises, giving employment to labor and forming the economic basis for the communities which have grown up around them. The largest sale made during the year, one of 852,000,000 board feet on the Olympic National Forest in Washington, is an illustration. This timber was awarded, under competitive bids, to a company which has cut nearly all the privately owned timber available to it and in default of obtaining public timber was faced with the alternative of ceasing operation and dismantling its plants, to the detriment of the community.

The establishment and development of national forests east of the Great Plains has aided in the stability and growth of the timber use. The cut of the year on these forests was 112,000,000 board feet and brought \$572,000. Much of this timber was made into other products than lumber.

A commensurate increase with that of the timber business has taken place in knowledge of methods for keeping the land growing timber. In 1905 no trained foresters had had experience in handling western tree species and very little was known of the practical silvicultural and fire-precautionary measures best for each of the western forest types. Many of the early sales were trials of theory in these matters. The results of research and of practical experience accumulated during 25 years under the leadership of competent foresters now furnish a basis for confident action. The study of cut-over areas after 10 to 25 years is the real test of the value of or errors in the methods of cutting and the protective measures applied when the sale was made. The national-forest timber resource has been made available for use under a system of regulation designed to provide that the output shall be continuous, that new crops shall replace those cut, and that stability and permanence shall be given dependent industries and communities. The technical information and skill is now available to handle the increasing volume of cutting so as to carry out fully the wise provisions of the basic law for national-forest administration.

At the close of the year over 2,000,000 cords of pulp wood on two tracts near each other in the mountains of Colorado were being advertised for sale and subsequently were awarded to the highest bidder among three reputable paper-manufacturing companies. This will constitute the first large-scale utilization of the spruces and firs of the Rocky Mountain region. These species have not been in demand as saw timber or tie material, and their use for paper making

has been prevented by the lack of paper mills in the region. The progressive depletion of the Lake States spruce explains the newly awakened interest of paper companies in the Colorado timber. The sale is, therefore, indicative of the continued trend of wood manufactures to the West as the eastern supplies of old timber approach exhaustion. It also indicates the increasing use of national-forest timber for pulp products, which is confidently expected to expand materially in future years.

Heretofore, large sales of pulp wood to form the chief source of supply for large paper mills have been awarded only in Alaska, and active operations there have necessarily been delayed for the engineering examinations now nearing completion which must precede the heavy investments in the development of water power and the construction of mills. Pulp wood has been cut on national forests in Maine, New Hampshire, North Carolina, Michigan, Minnesota, Idaho, and Washington, and shipped to established paper mills to supplement other supplies, and in Virginia chestnut wood from the forests has been used for paper making after the tannic acid has been extracted. The Alaska sales, the Colorado sales, and one of 510,100,000 board feet made during the year on the Snoqualmie National Forest, in Washington, are each expected to constitute the chief timber backing for paper mills. The timber will be cut not faster than growth will replace it within the tributary unit of which the sale area forms a part, thus providing for a permanent enterprise in each case.

The national-forest timber sale business of the calendar year 1929 is summarized in the Tables 9, 10, and 11.

TABLE 9.—Quantity and value of national-forest timber cut under sales, calendar year 1929

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	Board feet	Board feet	Board feet	Dollars	Dollars	Dollars
Alabama.....	3,000		3,000	20		
Alaska.....	47,462,000		47,462,000	71,409		71,409
Arizona.....	112,786,000	238,000	113,024,000	281,592	239	281,831
Arkansas.....	21,000,000	132,000	21,132,000	140,415	133	140,548
California.....	401,083,000	1,732,000	402,815,000	1,172,110	1,116	1,173,226
Colorado.....	54,189,000	798,000	54,987,000	150,803	776	151,579
Florida.....	6,104,000		6,104,000	19,716		19,716
Idaho.....	115,528,000	5,278,000	120,806,000	431,783	4,760	436,543
Michigan.....	5,198,000		5,198,000	9,964		9,964
Minnesota.....	5,789,000		5,789,000	22,920		22,920
Montana.....	36,506,000	3,774,000	40,280,000	105,524	4,016	109,540
Nevada.....	847,000	233,000	1,080,000	1,224	200	1,424
New Hampshire.....	14,267,000		14,267,000	91,943		91,943
New Mexico.....	15,438,000	618,000	16,056,000	36,558	644	37,202
North Carolina.....	14,412,000		14,412,000	49,797		49,797
Oregon.....	225,907,000	3,111,000	229,018,000	677,912	2,130	680,042
Pennsylvania.....	2,645,000		2,645,000	5,632		5,632
South Dakota.....	48,659,000	555,000	49,214,000	176,068	593	176,661
Tennessee.....	5,778,000	92,000	5,870,000	10,307	99	10,406
Utah.....	10,224,000	832,000	11,056,000	21,865	883	22,748
Virginia.....	15,038,000	9,000	15,047,000	41,908	10	41,918
Washington.....	184,053,000	232,000	184,285,000	398,725	147	398,872
West Virginia.....	1,663,000		1,663,000	5,211		5,211
Wyoming.....	57,696,000	1,279,000	58,975,000	162,680	1,187	163,867
Total, 1929.....	1,402,275,000	18,913,000	1,421,188,000	4,086,086	16,933	4,103,019
Total, 1928.....	1,319,738,000	16,876,000	1,336,614,000	3,751,297	15,142	3,766,439

¹ In addition, minor products not convertible into board feet were cut, value \$18,134.

² In addition, minor products not convertible into board feet were cut, value \$23,503.

TABLE 10.—Quantity and value of national-forest timber sold, calendar year 1929

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alabama.....	20,000	-----	20,000	95	-----	95
Alaska.....	39,560,000	-----	39,560,000	56,400	-----	56,400
Arizona.....	47,227,000	260,000	47,487,000	104,414	249	104,663
Arkansas.....	74,036,000	222,000	74,258,000	636,333	222	636,555
California.....	118,044,000	1,780,000	119,824,000	296,894	1,224	298,118
Colorado.....	28,078,000	852,000	28,930,000	69,411	891	70,302
Florida.....	43,810,000	-----	43,810,000	236,379	-----	236,379
Idaho.....	58,316,000	4,254,000	62,570,000	157,383	4,026	161,409
Michigan.....	3,077,000	-----	3,077,000	4,661	-----	4,661
Minnesota.....	22,953,000	-----	22,953,000	73,324	-----	73,324
Montana.....	58,829,000	4,438,000	63,267,000	188,691	4,675	193,366
Nevada.....	1,007,000	278,000	1,285,000	1,487	229	1,716
New Hampshire.....	12,218,000	-----	12,218,000	50,027	-----	50,027
New Mexico.....	32,017,000	834,000	32,851,000	89,225	825	90,050
North Carolina.....	14,288,000	-----	14,288,000	43,313	-----	43,313
Oregon.....	186,385,000	2,880,000	189,265,000	590,869	1,988	592,857
Pennsylvania.....	7,764,000	-----	7,764,000	24,124	-----	24,124
South Dakota.....	33,788,000	271,000	34,059,000	128,902	299	129,201
Tennessee.....	4,800,000	114,000	4,914,000	10,986	120	11,106
Utah.....	23,010,000	1,092,000	24,102,000	59,842	1,177	61,019
Virginia.....	18,611,000	3,000	18,614,000	28,990	3	28,993
Washington.....	171,525,000	171,000	171,696,000	360,104	108	360,212
West Virginia.....	530,000	-----	530,000	1,574	-----	1,574
Wyoming.....	32,175,000	1,377,000	33,552,000	85,099	1,247	86,346
Total, 1929.....	1,032,068,000	18,826,000	1,050,894,000	3,298,527	17,283	¹ 3,315,810
Total, 1928.....	2,669,996,000	19,920,000	2,689,916,000	7,765,647	18,020	² 7,783,667

¹ In addition, minor products not convertible into board feet were sold, value \$50,010.² In addition, minor products not convertible into board feet were sold, value \$22,629.

TABLE 11.—Number of national-forest timber sales, classified according to amounts of sale, by States, calendar year 1929

State	\$500 or under commercial sales	\$500 or under cost sales	Total	\$501 to \$1,000	\$1,001 to \$5,000	Over \$5,000	Grand total
Alabama.....	3	-----	3	-----	-----	-----	3
Alaska.....	210	-----	210	14	10	1	235
Arizona.....	1,068	185	1,253	-----	1	2	1,256
Arkansas.....	54	79	133	-----	-----	8	141
California.....	578	321	899	5	13	20	937
Colorado.....	651	208	859	4	13	2	878
Florida.....	121	-----	121	1	1	3	126
Idaho.....	902	1,315	2,217	15	14	8	2,254
Michigan.....	57	-----	57	1	-----	-----	58
Minnesota.....	203	-----	203	2	7	5	217
Montana.....	666	932	1,598	4	10	6	1,618
Nevada.....	70	102	172	-----	-----	-----	172
New Hampshire.....	170	-----	170	3	2	4	179
New Mexico.....	1,041	508	1,549	3	5	4	1,561
North Carolina.....	322	-----	322	2	7	3	334
Oregon.....	593	562	1,155	7	6	13	1,181
Pennsylvania.....	9	-----	9	3	2	1	15
South Dakota.....	284	58	342	1	12	11	366
Tennessee.....	217	40	257	1	2	-----	260
Utah.....	256	613	869	-----	-----	1	870
Virginia.....	377	2	379	1	2	1	383
Washington.....	207	35	242	7	11	12	272
West Virginia.....	22	-----	22	-----	-----	-----	22
Wyoming.....	249	270	519	1	4	2	526
Total, 1929.....	8,350	5,230	13,580	75	122	107	13,864
Total, 1928.....	7,934	5,630	13,564	42	113	72	13,791

PLANTING

The national forests contain over 2,000,000 acres of open, unproductive land that can be restored to productivity within a reasonable time only by tree planting.

Planting has not kept pace with other national-forest activities. The first 10 years of administration, from 1905 to about 1915, were a period of experimentation to develop practical low-cost methods. During the next 10 years the World War and the restrictions upon governmental expenditures that followed prevented any material expansion of the work. In 1916, 10,396 acres were planted or sown and in 1925, 11,565 acres. During the last five years there has been gradual expansion as small increases in appropriations became available. About 18,000 acres are now being planted annually, with nursery developments under way which when completed will permit an increase to about 25,000 acres, if the appropriation continues unchanged. The national forests now contain about 150,000 acres of successful plantations, after eliminating failures due to drought, fires, and other causes.

The expansion of the national-forest area in the Lake States and elsewhere is adding new lands in need of planting faster than the rate at which the work is now going forward. In the West, despite steady progress in reforesting old burns, disastrous fires have increased the denuded acreage, especially in northern Idaho, western Montana, and parts of Washington. Thus, the total area needing planting tends to increase rather than diminish. The program for the establishment of additional nursery capacity and enlarged planting operations calls for development on the eastern forests first, because of their accessibility to the centers of population and their potential productivity, with subsequent enlargement of the planting activity on the burned areas in the Rocky Mountain and Pacific Coast States. This program is already under way. In 1925, 37 per cent of the acreage planted was east of the Great Plains, in 1929 about 61 per cent.

The act of June 9, 1930, commonly referred to as the Knutson Vandenberg Act, set up a fiscal program for national-forest planting by authorizing appropriations for subsequent fiscal years. If appropriations are made in the amounts authorized, planting can be brought into balance with other activities on the eastern national forests, but no material enlargement in the West is possible.

The same act authorized the requirement of a special deposit by timber-sale purchasers to be used for planting the area cut over, if necessary because of any failure of desirable natural reproduction. This authority will be of great aid in some exceptional cases where the clear-cutting of the old timber crop and the planting of a new one is the best practice, economically or silviculturally. Any excess of such a deposit over the cost of doing the work will be handled as a receipt from the sale of the timber.

The first planting on national-forest land in Wisconsin was done in the spring of 1930, when about 400 acres of recently acquired open land on the Moquah purchase unit were reforested with trees from the nursery at Cass Lake, Minn. A new nursery in Wisconsin is one of the urgent needs.

It will be 1933 before the nursery enlargements now in progress are fully reflected in acreage planted. The areas planted and sown in the calendar year 1929 are shown in Table 12.

TABLE 12.—Planting and sowing on national forests, by States, calendar year 1929

State	Area planted	Area sown	Total	State	Area planted	Area sown	Total
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>		<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Michigan.....	8,779.70	-----	8,779.70	West Virginia.....	77.60	0.50	78.10
Idaho.....	2,226.94	-----	2,226.94	Virginia.....	48.07	-----	48.07
Minnesota.....	1,468.00	-----	1,468.00	California.....	33.73	2.00	35.73
Washington.....	1,303.00	-----	1,303.00	Utah.....	21.25	-----	21.25
Nebraska.....	1,215.17	-----	1,215.17	North Carolina.....	15.00	-----	15.00
Colorado.....	1,164.99	-----	1,164.99	Tennessee.....	12.25	2.00	14.25
Oregon.....	782.50	-----	782.50	Oklahoma.....	13.60	-----	13.60
Montana.....	321.64	-----	321.64	Nevada.....	.20	-----	.20
Florida.....	308.22	5.00	313.22				
Pennsylvania.....	298.30	1.50	299.80	Total.....	18,196.59	11.00	18,207.59
Wyoming.....	106.43	-----	106.43				

RANGE

GENERAL RANGE AND LIVESTOCK CONDITIONS

Except in the Southwest, the winter of 1928-29 was severe. A highly erratic spring and summer followed. Most of Colorado and portions of Wyoming had a dry, cold, late spring, more than usual summer rain, and a forage crop above normal but of less than average quality. In other portions of Wyoming, all of Montana, and pretty generally throughout the intermountain and Pacific coast regions a fairly good spring was succeeded by the highest temperatures and lowest rainfall for the longest period known for many years. Ranges were generally too closely grazed, some livestock had to be removed before the end of the grazing season, and weights of animals were lightly under normal.

In the Southwest the situation was somewhat improved over previous years. Despite a preceding season of deficient rainfall, livestock entered the winter of 1928-29 in fair to good condition but with an inadequate supply of winter feed. A generally mild winter and light snowfall, together with the good condition of national-forest ranges brought about by conservative stocking, limited heavy losses to local areas. The soundness of a policy which reserves a good supply to meet emergency conditions was amply proved. On most of the national-forest ranges in Arizona and New Mexico the spring brought considerable moisture and favorable growing conditions, but some areas were extremely dry until the summer rains, which were as a rule abundant and timely, but in some localities inadequate. An extremely dry fall followed, with a serious shortage of stock water in places; but abundant precipitation in December and January greatly improved the situation everywhere. With some exceptions, the forage was above average in growth, but the weights of animals and the calf and lamb crops were only fair to good.

Generally throughout the West the subnormal precipitation of the last few years has diminished the underground water supplies. The resulting shortage of water for irrigation and domestic purposes has led to some demands for the removal of livestock from forests upon the erroneous assumption that grazing is denuding the watersheds. Recent public appreciation of the value of ground cover, whether it

be brush, timber, or grass, in preserving watersheds is most desirable. Experience with these dry periods emphasizes the necessity of stocking ranges conservatively rather than on the basis of the good year. Surplus feed is an insurance against range depletion and loss of live stock values during emergency periods, as well as an evidence that watershed values are being conserved.

Favorable cattle markets throughout 1929 gave growers a stronger financial position than for some years. This in turn was reflected in better care and management of herds on the national forests and better satisfied permittees. In contrast, the condition of the sheep industry was rather discouraging. Wool dropped to the lowest level since 1921, and lamb prices declined. The year marked the end of a cycle of prosperity in the business, and much pessimism prevails as to the future.

Times of depression bring out the value of the national-forest range, with its assured stability and encouragement for the grower through efficient management to offset low prices by lowered death losses and increased weights of lambs. Efficient labor and good supervision during the summer season are essential alike to the success of the business and to good range management. The need of the latter has been made more obvious and more urgent by the long periods of deficient precipitation, which have left their mark on all western ranges. The permanence of the effect probably can not be fully determined until better seasonal conditions arrive. It is certain that for the present the volume of production of forage has been decreased and range capacity impaired. For this reason careful attention has been given to reducing use promptly when the signs of range decline appear.

TABLE 13.—*Grazing permits issued and number of stock grazed on the national forests, by States, calendar year 1929*

State	Cattle, horses, and swine				Sheep and goats		
	Permits issued	Stock grazed			Permits issued	Stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Alabama.....	1	8	2				
Alaska.....	3	28					
Arizona.....	1,042	182,659	1,997	391	125	323,736	1,300
Arkansas.....	19	205					
California.....	1,824	146,371	5,606	265	362	431,789	1,900
Colorado.....	2,878	274,873	4,111		925	1,077,223	7,000
Florida.....	5	164			3	1,005	
Idaho.....	2,756	118,773	8,118		1,028	1,378,240	
Montana.....	1,929	121,216	9,255		495	612,828	
Nebraska.....	32	10,808	498				
Nevada.....	328	48,318	2,021		153	313,534	
New Hampshire.....	17	139	38				
New Mexico.....	1,958	80,716	3,341	134	294	243,904	10,400
North Carolina.....	50	286	1	14	13	124	
Oklahoma.....	51	2,528	80				
Oregon.....	1,072	83,848	3,134		504	657,172	
South Dakota.....	521	25,271	1,059		35	30,283	
Tennessee.....	31	230	3		5	149	
Utah.....	4,139	109,114	4,146	49	2,152	778,884	9,000
Virginia.....	62	666	1		17	467	
Washington.....	393	12,495	538		142	169,535	
West Virginia.....	8	82	2		23	599	
Wyoming.....	754	103,667	4,220		298	631,247	
Total, 1929.....	19,873	1,322,465	48,171	853	6,574	6,650,719	15,400
Total, 1928.....	19,967	1,335,903	51,956	1,206	6,457	6,509,421	17,000

With 13,438 fewer cattle but 141,298 more sheep permitted in 1929 than in 1928, and with 5 sheep reckoned as the equivalent of 1 cow in forage requirements, the national-forest ranges carried during 1929 a net livestock increase over 1928 equivalent to 14,822 more cattle. Compared with 1925 the number was 118,786 less—about 4.3 per cent. In the same period the number of livestock in the 11 Western States declined about 15.5 per cent. Fluctuations in numbers and class of stock must be expected in response to varying economic and physical conditions. The recent swing toward sheep will probably now be reversed.

STABILITY OF RANGE USE

National-forest range administration has kept up with economic requirements. When the forests were first placed under the Department of Agriculture in 1905, most of the ranges were seriously overgrazed. Some were in about the same condition that now characterizes a large part of the public domain. One of the first tasks imposed on the Forest Service was to reduce heavily the numbers of stock admitted. Exclusion began with the transient and nomadic stock. On the Sierra Forest in California, for example, some 400,000 head of sheep were excluded at the outset. Other forests were similarly overgrazed by nomadic bands of sheep, while resident owners were in many cases grazing far more cattle, horses, and sheep than the range would safely carry.

In order to permit adjustment in the business, a policy of gradual reduction was adopted. It was not until about 1910 that the conditions on the various ranges were known well enough to determine how great reductions would be requisite. Many areas were then, and even later, still seriously overgrazed. There were no criteria for regulating the use of grazing lands until the Forest Service developed them. The working out of plans and policies, the settlement of conflicts, the determination of seasons of use, the prevention of premature grazing, the definite assignment of allotments to individuals, and the reduction in numbers of stock all required time to work out. The acreage of the grazing lands has been another important factor. Over 30,000,000 acres have, for one reason or another, been withdrawn from grazing use during the past 20 years. About 20,000,000 acres, including some of the very best grazing lands, were eliminated from the forests. Over 4,000,000 acres have been closed to the grazing of livestock in the interest of game, timber, watershed, and recreational protection. The equivalent of approximately 2,000,000 acres has been withdrawn from grazing use through reductions in the permitted number of domestic stock on the 278 Federal and State game refuges. Some 2,250,000 acres were listed, filed on, and patented under the forest homestead act of June 11, 1906. This land also included some of the very best grazing land, and its settlement often cut out the heart of the range. The encroachment of timber reproduction due to protection of the forests from fire has gradually reduced the carrying capacity of the 42,000,000 acres of timberland used for grazing purposes by an estimated 10 per cent, the equivalent of an area decrease of over 4,000,000 acres. All told, these changes have virtually reduced the usable grazing lands by 20 to 30 per cent.

The actual decline in the number of stock grazed, with sheep reduced to cattle on a ratio of 5 to 1, is less than 15 per cent.

The land in the national forests is constantly changing. Additions are being made through land exchange and purchase, while some grazing lands have been passing from public ownership. Within recent years, however, the additions have usually been timber-producing lands of low value for grazing. Notwithstanding these changes during the past 20 years, the ranges have maintained a stable livestock industry. Overgrazing conditions have largely been overcome and the depleted forage resource has been built up to a state of sustained productivity without seriously interfering with the business of the range users.

Economic conditions, of course, play an important part in the numbers of livestock grazed year by year. From 1910 to 1918 the number of cattle in the 11 Western States increased 39 per cent, while the number on the national forests increased 55 per cent. In 1919 the number in the 11 Western States declined 5 per cent, but the number on the forests maintained the 1918 level. From 1918 to 1929 the number on the national forests declined to 4.5 per cent below the 1910 level, and the number in the 11 Western States declined in about the same proportion. Approximately the same comparison can be made with sheep.

The large increase in number of stock both in the Western States and on the national-forest ranges from 1916 to 1918 was due to war requirements, and the subsequent decline was largely postwar deflation. The ranges were heavily overstocked to meet the war emergency, and the economic adjustments which followed brought about a reduction which would have had to be made anyway. In some instances it is still in process. During it stockmen have taken advantage of the provision in the regulations authorizing a continuance of their established preferences upon application, without continuous use. All such preferences impose an obligation on forest range which must be met when the permittee restocks. In 1929 preferences were carried over on 100,000 cattle and 436,159 sheep by the application of the nonuse provision of the regulations. These numbers are not included in any of the above tables. Neither do the tables include over 100,000 cattle and horses grazed on the national forests free of charge by settlers, miners, tourists, and the like.

The number of stock grazed on the forests is about 3 per cent less than the number for which permits are issued. This difference is due to the inability of the permittees to determine at the time they make application the exact number of stock they may have after spring losses and when the grazing season opens.

Numbers alone are not a true criterion of what the forests have really supported during the last 20 years. Improved practices of range livestock management which have been introduced since 1910 have increased the forage requirements for a given number of animals covered by permit. In 1910 the number of lambs averaged about 75 per cent of the number of ewes; in 1929, about 95 per cent. Animals under 6 months of age are not counted or charged for. Further, as a result of early lambing and the improvement of breeds

in the mutton type, lambs are larger and older now when they go on the forests than they were in 1910 and therefore consume a greater amount of forage. Improvement in breeds has materially increased the weights of both cattle and sheep. Without adequate feed, however, improvement in breeds would not accomplish full results in increasing weights. For all classes of marketable animals weights have increased greatly during the past 20 years.

In recognizing established preferences it has been a fundamental principle throughout that no rights are acquired, but that the grazing privilege is subject to revocation at any time the land is being injured or is needed for other purposes. The regulations further provide for the admission of new applicants by a reduction in numbers of stock of the larger owners. The number of cattle and horse owners during the past five years has averaged 21,362 and of sheep and goat owners 6,207. The average number of cattle per permittee in 1929 was 70 and of sheep 1,023.

In 1912 the average number of cattle per permittee was 71, or 1 more than in 1929, and of sheep 1,421, or 398 more than in 1929. This decline was due partly to the depression in the sheep business from 1919 to 1922, but also partly to the fact that over 1,200 more permittees grazed sheep on the national forests in 1929 than in 1912. Changes from cattle to sheep have also been an influencing factor. The larger owners in both classes of stock are practically the same as were using the forests in 1912, with a slightly decreased average number of stock per permit.

For all permits covering over 200 cattle the number per permit averaged in 1912, 524 as against 445 in 1929. For sheep permits covering over 2,500 head the average in 1912 was 4,812, and for 1929, 4,575; but in 1912, 93 per cent of the cattle permittees grazed under 200 head each, and 87 per cent of the sheep permittees grazed under 2,500 head each. In 1929 the corresponding percentages were: For cattle, unchanged; for sheep, 91. In 1912 the cattle permittees for over 200 head grazed 50 per cent of all the cattle permitted, and in 1929 47 per cent, while the sheep permittees for over 2,500 head grazed 44 per cent of all the permitted sheep in 1912, as against 38 per cent in 1929.

These figures make clear that while the trend has been toward a wider distribution of the grazing privilege and a decreasing proportion of range use by large owners, the change over a considerable period of years has been such as to indicate a high degree of conservatism in the procedure and stability for the industry, not violent or drastic disturbances. In the report for last year the stability of range use was brought out from another angle, through a comparison between the number of stock and permittees and the acreage of usable range in 1909 and 1928. The estimate of the area of usable range in 1909 shown in that comparison failed to make allowance for all the factors that require to be given weight in working out the comparative showing. These factors have already been explained above. A corrected comparison, with 1929 substituted for 1928, is shown in Table 14.

TABLE 14.—*Number of permits and number of stock grazed in the western national forests in 1909 and 1929*

Year	Cattle, horses, and swine			Sheep and goats			Area in national forests	
	Permits	Stock	Average per permit	Permits	Stock	Average per permit	Total	Usable range
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Acres</i>	<i>Acres</i>
1909.....	22, 163	1, 585, 905	72	5, 074	7, 819, 594	1, 541	161, 534, 792	115, 000, 000
1929.....	19, 677	1, 369, 620	70	6, 513	6, 663, 854	1, 023	132, 922, 823	83, 820, 600

Using the accepted ratio of 5 sheep as the grazing equivalent of cow, the average area per head of stock was 37 in 1909, as against 31 in 1929. That the average carrying capacity per acre is substantially greater than it was in 1909 is obvious. By conserving and building up the range resource as well as by its policies relating to range use, national-forest administration has been the principal means of securing to the dependent range livestock industry a highly stable in place of a highly unstable condition.

TERM PERMITS

As shown in Table 15, term permits were issued during 1929 for 50.7 per cent of the cattle and 61.3 per cent of the sheep, an increase over 1928 of 3.2 per cent for cattle and 0.3 per cent for sheep.

TABLE 15.—*Term or 10-year permits for grazing stock on the western national forests, 1929*

Region	Number of term permits issued		Per cent of total		Number of stock under term permits		Per cent of total		Total number of permits issued		Total number of stock permitted	
	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats
1.....	557	139	27.2	24.0	57,935	250,123	41.6	32.9	2,050	579	139,338	760,120
2.....	1,033	357	25.6	30.6	154,929	684,362	39.9	44.0	4,036	1,168	388,761	1,554,660
3.....	922	165	31.2	39.6	140,062	399,626	50.9	60.9	2,951	417	275,175	656,040
4.....	6,681	2,949	90.9	88.3	287,483	2,449,431	84.4	90.7	7,351	3,341	340,443	2,701,380
5.....	338	83	18.5	22.9	47,683	133,975	31.4	30.8	1,824	362	151,687	435,380
6.....	190	248	13.0	38.4	20,254	349,219	20.0	40.9	1,465	646	101,152	852,790
Total..	9,721	3,941	49.4	60.5	708,346	4,266,736	50.7	61.3	19,677	6,513	1,396,556	6,960,400

NONUSE OF RANGE

As has been mentioned in previous reports, nonuse of range has been granted to permittees with established preference when the permittee is prevented from exercising his privilege by business requirements. In 1929 grazing privileges were thus retained for nearly 100,000 cattle and over 430,000 sheep. For cattle this was the same number as in 1928, but for sheep an increase of over 82,000 head. With a further decline in the sheep industry threatened, an increased demand for nonuse and for changes from sheep to cattle is probable. The Forest Service is prepared to meet that situation as it has been met in the past.

Nonuse will be granted all deserving applicants who are unable to place all or a part of their preference number of stock on the range because of foreclosure of mortgage or other circumstances beyond their control. If the range thus vacated needs a rest, it will be closed to use. In cases of this kind the length of the nonuse period will be determined by the needs of the range. If the range is in good condition, it may be used temporarily by other approved applicants as a measure of relief to other ranges or to accommodate new applicants on a temporary basis.

Action on applications for change in class of livestock will likewise be governed by the present policy, stated in my report for 1929. Execution of these general policies rests upon local forest officers with full authority. This local control and flexibility of regulation meets the fluctuating demands of the livestock industry in a way that is not often paralleled in comparable private business transactions.

RANGE MANAGEMENT

The development of range-management plans during 1929 made satisfactory progress. Range users are taking a more active interest in them and are generally accepting them as indispensable in securing the greatest returns. Time emphasizes the relation of labor to the successful application of the plans. As a rule the man in charge of stock is perforce given wide latitude to exercise his judgment without close supervision. Nevertheless, the extent to which the owner shows interest, gives general directions, keeps his camps properly supplied with food, salt, etc., pays adequate wages, and classifies his herds so as to permit the kind of management range conditions dictate will by and large determine his profits. This is especially true in periods of depression, when a few pounds of increased weight in lambs or beef at least partly make up for lower market prices.

Supervision and management of the herds while on the range is a distinct responsibility of the owner, which the Forest Service does not attempt to assume, although it can and does prescribe, in cooperation with the stockmen, the manner by which the best results will be secured both from a business and range standpoint. As a rule the best range management is the best business practice. If the range is conservatively stocked so that full forage production will continue, with correct seasonal use and uniform utilization of the whole range, success of the business is promoted. When the range is overgrazed as a whole or when indifferent or poor management results in overgrazing some areas and leaving others untouched, the user pays the penalty in decreased returns and all the attendant evils of range abuse occur. Good management of ranges is not a mere theory, but a fact demonstrated by practical application on some range in every national forest on which livestock graze.

The elimination of bad practices is the goal of the Forest Service. In striving to reach this goal, however, long-standing prejudices and opinions must be encountered. In some cases these lead to an accusation of arbitrary and bureaucratic requirements when the regulatory measures are imposed that are necessary to keep national-forest land fully productive and to insure the greatest net public benefit in timber, game, and livestock production and in watershed protection. To redeem its responsibilities under the law, however, the Forest Service must require observance of these measures.

The question has been raised whether the regulations and range management practices are, after all, adapted to ranges where timber production and watershed protection are not involved. The regulations and practices are the outcome of 25 years of experience, experimentation, and practical trial and test on all kinds of land. They are flexible, permitting the kind of management the specific land resources dictate. In other words, the values represented and their requirements are the governing factors. On most of the national-forest ranges it is true that more than one resource is involved and that management of the land must involve plans for the best correlated use. On the other hand, forage may be the dominant, if not the only, resource. Where this is the case its protection and use forms the main or sole foundation for the plans and practices.

RANGE IMPROVEMENTS

Previous reports have stressed the need of range improvements and furnished examples of their relation to good administration. Increased appropriations during the past few years have aided greatly in providing the most needed improvements. Nevertheless, as shown in Table 16, the estimated cost to the Government of those still awaiting construction virtually equals the expenditures to date. Continued progress is essential to efficient range use.

TABLE 16.—Range improvements constructed and needed on national forests to December 31, 1929

RANGE IMPROVEMENTS CONSTRUCTED

Type of improvement	National forest region						Total
	1	2	3	4	5	6	
Boundary and drift fences.....miles..	416	1,002	6,041	642	1,967	723	10,791
Water development.....number.....	319	400	2,969	992	548	373	5,601
Driveways.....miles.....	1,087	1,324		626	7	910	3,954
Bridges.....number.....	25	20	17	26		13	101
Trails.....miles.....	1			117		8	126
Corrals.....number.....	68	77	30	73	5	115	368
Cabins.....do.....	36					55	91
Pastures.....do.....	15				1		16
Poison eradication.....acres.....	95	11,036	230	3,177	881	29	15,448
Salt troughs.....number.....	2					1,250	1,252
Cost to stockmen.....dollars.....	91,685	91,911	2,358,184	165,484	156,275	164,373	3,027,912
Cost to Government.....do.....	201,707	147,079	245,119	121,413	91,526	68,178	875,022
Total cost.....do.....	293,392	238,990	2,603,303	286,897	247,801	232,551	3,902,934

RANGE IMPROVEMENTS NEEDED

Boundary and drift fences.....miles..	233	231	3,696	376	142	1,674	6,352
Water development.....number.....	340	167	892	765	419	662	3,245
Driveways.....miles.....		87		166	10	390	653
Bridges.....number.....		2	1	30		5	38
Trails.....miles.....			90	161		5	256
Corrals.....number.....		7	119	9		219	354
Cabins.....do.....						102	102
Pastures.....do.....					19	9	28
Poison eradication.....acres.....	4,645	4,383	250,971	6,594	490	809	267,892
Salt troughs.....number.....						1,937	1,937
Cost to stockmen.....dollars.....	765	23,728	221,651	126,439	4,272	324,918	701,773
Cost to Government.....do.....	408,535	77,046	382,712	142,580	76,725	84,272	871,870
Total cost.....do.....	109,300	100,774	604,363	269,019	80,997	409,190	1,573,643

GRAZING TRESPASS

The number of grazing trespass cases has gradually declined for several years but there are still too many. Better observance of the regulations will enable local forest officers to divert the time and effort expended on trespass to more productive channels. The impounding regulation continues to play an important part in eliminating trespassing animals from national-forest range, and since its validity was upheld by court decision it will be more universally applied.

Table 17 shows the losses of livestock during 1929 on the national forests from all causes. The losses of cattle due to poisonous plants decreased over 4 per cent, but sheep losses showed an apparent increase of over 5 per cent. In part this was because more complete data were obtained than for the previous year, but in part was due to weather conditions.

There is great need of more knowledge of varying plant toxicity, the chemical constituents of the plants as related to requirements of range animals, and the place of supplemental feeds and salt in supplying any nutritional deficiencies. Each poisonous plant presents a special problem, and its control depends upon basic information obtainable only through research. Over half the loss of cattle is caused by larkspur poisoning, a plant for which control methods have been fairly well worked out and are being applied on national-forest range. The value of all animals lost in 1929 from poisonous plants, over \$600,000, illustrates the importance of further study and increased prevention.

The losses due to predatory animals and other causes were slightly less than in 1928. The effective work of the Bureau of Biological Survey in control of predatory animals is no doubt reflected in this decrease. Such an enlarged program as is now before Congress for this control work is urgently needed. It is estimated that the loss of game from predatory animals is over one and one-half times the number killed annually by hunters.

TABLE 17.—*Livestock losses, 1929*

CATTLE AND HORSES

Region	Stock lost from all poisonous plants, including larkspur		Stock lost from predatory animals and other causes exclusive of poisonous plants		Total stock lost, all causes	
	Number	Value	Number	Value	Number	Value
1.....	237	\$15,800	559	\$37,265	796	\$53,065
2.....	2,114	140,935	2,029	135,265	4,143	276,200
3.....	694	46,265	2,730	182,000	3,424	228,265
4.....	2,053	136,865	1,502	100,135	3,555	237,000
5.....	626	41,735	889	59,265	1,515	101,000
6.....	239	15,935	556	37,065	795	53,000
Total.....	5,963	397,535	8,265	550,995	14,228	948,530

SHEEP AND GOATS

1.....	2,218	\$22,180	17,397	\$173,970	19,615	\$196,150
2.....	4,915	49,150	19,314	193,140	24,229	242,290
3.....	2,063	20,630	5,124	51,240	7,187	71,870
4.....	10,191	101,910	39,241	392,410	49,432	494,320
5.....	1,674	16,740	6,856	68,560	8,530	85,300
6.....	2,822	28,220	12,704	127,040	15,526	155,260
Total.....	23,883	238,830	100,636	1,006,360	124,519	1,245,190

RECREATION AND GAME

The estimated number of persons visiting the national forests in 1929 was 31,758,231, which was greater by 38 per cent than in the preceding year and more than ten times greater than in 1917. Specifically, the estimates included 376,780 special-use permittees and their guests, 1,795,861 hotel and resort guests, 1,902,961 campers, 3,056,456 picnickers, and 24,626,173 transient motorists.* Inevitably these estimates involve certain duplications, since the same person may visit and be counted in several different forests or the same forest several different times in the year; their chief significance is for year-to-year comparisons, for which they are approximately accurate.

During the year 307 additional public camp grounds were at least partially equipped with facilities essential to public health and convenience and the protection of public property. The total number of national-forest camp grounds now wholly or partly improved is 1,493. Many additional facilities must be installed before these areas will adequately provide the safeguards to public health and property necessitated by the presence of many millions of people within the national forests during the periods of greatest fire danger. Expenditures for camp-ground improvement during 1929 totaled \$51,086. The entire cost of the existing system of camp grounds has been \$329,922, of which \$48,642 was contributed by public or private cooperators in cash, materials, or labor.

Many communities established originally on the bases of timber, forage, mineral, or agricultural resources now either depleted or inadequate to sustain modern standards of life have been able to maintain or enlarge their incomes through various forms of service to the millions who visit the national forests, and have thus become economically dependent upon the recreation and game resources of the forests. In consequence, these resources have assumed a new economic importance, frequently ranking with and in some cases outranking other natural resources. The proper conservation and development of the recreation and game resources, therefore, is regarded as a distinct obligation by the Forest Service. Much which markedly will enhance the value and service of these resources and promote the growth and progress of dependent communities can be accomplished by more intensive planning, development, and management of outstanding areas. It would be good national economy to meet the cost of such work.

During the year the study of the Mount Hood area, in Oregon, by the special committee appointed by the Secretary of Agriculture was completed, and the findings of the committee were summarized in a report in many respects epochal in its suggestion of new principles and policies for the management of such areas. The report has been printed as Senate Document No. 164, Seventy-first Congress, second session. At the close of the year a partial application of the committee's recommendations was under way, and it is hoped eventually to carry out the program substantially as outlined.

Table 18 shows the estimated number of big-game animals and beaver on the national forests. During the last five years the esti-

mated number of antelope has increased 35 per cent, of black or brown bear 9 per cent, of deer 32 per cent, of elk 15 per cent, of mountain goats 18 per cent, and of mountain sheep 2 per cent, with decreases of 37 per cent in grizzlies, 86 per cent in caribou, and 15 per cent in moose. Unless more protection is afforded the grizzly other States will be in the class of California, where this wonderful animal is now extinct. The decrease in caribou is due largely to the disappearance of the herd on one forest adjoining Canada, and it is assumed the herd has shifted its range to Canada. More reliable estimates may be and probably are responsible for the apparent lower number of moose.

TABLE 18.—*Number of big-game animals and beaver on national forests, by States, estimated as of December 31, 1929*

State	Antelope	Bear		Caribou	Deer	Elk	Moose	Mountain goat	Mountain sheep	Beaver
		Black or brown	Grizzly							
Alaska		¹ 5,710	² 2,600	20	62,400	12	560	10,000	1,000	4,000
Alabama					250					
Arizona	3,929	534	5		84,832	1,070			274	395
Arkansas		3			1,530					
California	900	11,400			254,475	193			690	225
Colorado	110	2,641	13		33,315	10,286		12	3,374	40,123
Florida		37			775					6
Idaho	2,585	5,603	135		62,288	8,828	635	3,195	1,512	15,579
Montana	537	5,646	523		51,890	12,958	1,363	4,283	2,140	17,051
Nebraska					75				5	
New Hampshire		830			3,200					
New Mexico	1,000	789	14		57,785	319			175	1,345
Nevada	190				6,440				145	275
North Carolina		145			4,852	51				
Oklahoma	9	4			325	375				
Oregon	159	5,564			81,455	7,699	2		50	3,712
Pennsylvania		200			3,000	10				60
South Dakota	390				5,060	321				1,585
Tennessee		22			148					
Utah		466	8		45,729	2,648			134	3,000
Virginia		700			110	75				
Washington		8,325	19		28,598	9,099		3,560		10,495
West Virginia		250			17					
Wyoming	410	1,795	190		13,910	28,728	2,594		2,829	8,811
Total	10,219	50,664	3,507	20	802,459	82,672	5,154	21,050	12,328	106,662

¹ Black bear only.

² Includes Alaska brown bear.

It is important that the national-forest wild-life resource have careful study, planning, and administration. The national forests constitute the largest and best big-game grounds in the country. They are maintained at public expense for the use and benefit of all the people. Unlike the private game preserves, they keep open for the everyday American opportunities for the enjoyment of sport and recreation which in European countries are restricted to the privileged few. They should be so administered as to combine a democratic system of use with scientific game propagation and management. This requires a coordination of Federal and State action, based on a clear understanding of the problems involved, and a common purpose. Wherever through game production the principle of

highest and fullest use of the national forests can be served, game-management plans are needed.

These plans are based on facts obtained through studies conducted by the Bureau of Biological Survey and through the observations of local forest officers. The essentials are to determine the kinds of game to which each individual area is adapted, the number of animals it will support, the number that may be removed each year while still maintaining an adequate breeding stock, the season when hunting may be permitted without undue disturbance or injury to the herd, and the needs of other resources. Since the protective phases of game administration are governed by State laws, it is fundamental that these laws be based on the best knowledge, and that they be well designed. The problems of game management are sufficiently important to employ the combined resources both of the State and of the Federal agencies concerned, and cooperative relationships are not only desirable but imperative if the best results are to be attained. The objectives are the same and the combined efforts of all available agencies will be none too great to keep our lands and streams fully productive of game and fish.

Forest officers assisted in State law enforcement as indicated in Table 19.

TABLE 19.—*Game protection by forest officers, 1929*

State	Cases reported to State for prosecution	Convictions secured	Cases reported to State for investigation	Convictions secured	Cases handled by forest officers			Total number of violations	Licenses issued by forest officers	Licenses examined by forest officers
					Dismissed with warning	Arrests by forest officers	Convictions secured			
Arizona.....	20	17	16	9	9	10	7	56	86	4,717
California.....	75	48	88	22	18	16	14	197	1,810	16,228
Colorado.....	48	34	21	4	20	1	1	90	-----	2,336
Idaho.....	28	10	34	17	9	33	25	104	760	2,611
Montana.....	-----	-----	-----	-----	-----	26	25	26	516	3,124
Nevada.....	-----	-----	-----	-----	-----	-----	-----	-----	38	200
New Mexico.....	8	5	-----	-----	15	19	15	42	-----	1,888
Oklahoma.....	2	2	15	2	-----	1	1	18	-----	10
Oregon.....	30	20	111	23	1	14	4	156	10	748
South Dakota.....	1	1	2	-----	1	-----	-----	4	66	28
Utah.....	12	6	12	3	4	3	2	31	639	3,273
Washington.....	11	6	6	-----	4	1	1	22	206	859
Wyoming.....	13	7	27	6	1	19	19	60	422	2,048
Total.....	248	156	332	86	82	143	114	806	4,553	38,065

Last year's report stated that the national forests contain over 100 State game refuges. Actually there are 258 State refuges on over 100 forests. They are in 20 different States and cover 19,652,580 acres. The largest number is in New Mexico, but the largest acreage is in Idaho. Table 20 presents further details.

TABLE 20.—*Game refuges on national forests, December 31, 1929*

State	State game refuges		Federal game preserves		Game areas by administrative restrictions	
	Number	Acreage inside forest	Number	Acreage inside forest	Number	Acreage
Alabama.....	1	16,000				
Alaska.....			1	140,681		
Arizona.....	23	1,402,601	2	793,377		
Arkansas.....			5	21,500		
California.....	31	2,034,853	3	48,343	2	19,800
Colorado.....	18	2,666,484			24	202,607
Florida.....	1	60,000				
Georgia.....			1	14,000		
Idaho.....	20	3,033,578			8	644,818
Montana.....	19	1,213,831			42	573,030
Nebraska.....	1	206,026				
Nevada.....	10	1,155,282				
New Hampshire.....	3	7,960				
New Mexico.....	55	1,134,127	1	45,515		
North Carolina.....	2	31,010	1	98,381		
Oklahoma.....			1	60,800		
Oregon.....	11	735,226			2	166,600
Pennsylvania.....	2	17,860				
South Dakota.....	2	26,060	2	49,908		
Tennessee.....			1	30,000		
Utah.....	10	1,157,526			1	5,000
Virginia.....	5	7,200				
Washington.....	24	2,284,058			1	13,517
West Virginia.....	2	23,000				
Wyoming.....	18	2,739,898	2	84,450	7	114,900
Total.....	258	19,652,580	20	1,386,955	87	1,740,272

The average size per refuge varies widely among States. In most instances the refuges first established were large. The generally accepted principle now, however, is that many small refuges are better than a few large ones. Many State refuges are entirely too large to serve the purposes intended advantageously. Although readjustments are urgently required, they are difficult to secure, since in most cases they necessitate changing State laws. Immediate remedial action is imperatively needed, especially on those refuges now overstocked with big-game animals, where overgrazing is occurring.

Cooperation is greatly aided wherever States place broad regulatory powers in the hands of a qualified nonpolitical State fish and game commission, with authority to regulate the opening and closing of game refuges and other areas as well as to establish seasons, bag limits, etc., in accordance with the particular requirements of each locality. Game administration should be based on facts rather than sentiment. The difficult problem that formerly existed in Arizona is now being worked out with the State commission along cooperative lines and without confusion, controversy, or misunderstanding. In fact, the adoption by Arizona of its new game code was one of the most progressive steps in game administration ever taken by any State. That code is based on logic, good common sense, and scientific facts.

Critical game-refuge situations due to overstocking exist in New Mexico, Idaho, Montana, Utah, Arizona, and Wyoming, and similar situations in other States seem inevitable. It is hoped that remedial measures may be applicable before injury to the herds, range, and other resources becomes too serious.

Federal preserves or refuges established on the national forests by specific acts of Congress afford adequate protection where public sentiment is indifferent and State laws ineffective, or where a particular species of game animal or bird is approaching extinction and its preservation is of national importance. They also serve as demonstration and experimental areas on which research may be conducted and the results applied in a scientific manner. The Grand Canyon game preserve, on the Kaibab Forest, has afforded a striking illustration of the problems of game administration connected with the need to limit the number of animals to the productive capacity of the area and to provide a workable system for removing any surplus. Regulated hunting in all that the term implies has been established on this preserve, affording the first instance of such regulation in the history of American public administration of game areas. One notable fact is that during the past five years 5,261 hunters have occupied the area without a fatality and with only one accident.

WATER POWER

On June 30, 1930, 253 water-power permits or easements issued by the Department of Agriculture were outstanding, of which 171 require the payment of an annual rental, while 82 are free permits. Fifty-eight of the rental permits or easements and 60 of the free permits are for power projects, with an estimated average output at minimum discharge of 515,565 horsepower for the rental permits and of 25,970 horsepower for the free. Permits or easements involving transmission lines only included 113 rental, with a length of 929.22 miles of line within the forest boundaries, and 22 free, with a length of 155.40 miles.

The Federal water power act, approved June 10, 1920, provided that the work of the Federal Power Commission shall be performed by and through the Departments of War, Interior, and Agriculture, and their engineering, technical, clerical, and other personnel, except as may otherwise be provided by law. Under this provision the Forest Service, with its own personnel, has done a very large amount of field engineering and supervision work for the commission. At the request of the commission the Forest Service was supervising at the close of the fiscal year the operations of 332 permittees or licensees, a net increase of 37. During the year the commission requested field investigations and reports in 70 cases of application for permit or license. The Forest Service reported on 61 cases and also made several valuations and appraisals. Of the 102 projects for which application was received by the commission during the year 56 involved the use of national-forest land. The regional foresters issued 13 permits for projects of 40 horsepower or less and for periods not exceeding 10 years.

The new Federal water power act of June 23, 1930, provides for a commission of five, to be appointed by the President. The commis-

sion is authorized to employ such engineers, accountants, legal advisers, and other officers and employees as are necessary in the execution of its functions. At the request of the commission the Forest Service has handled valuation and accounting work on certain cases. Prior to December 12, 1929, nearly all of these cases concerned relatively small investments, but in accordance with the commission's request of that date the Forest Service is now assisting on some 10 or more important and difficult cases. Participation in the engineering investigations and reports and supervision of the operations of permittees and licensees is of decided value to the Forest Service in its administration of national-forest lands and resources. Assistance in handling the commission's valuation and accounting work is gladly given whenever the Forest Service can effectively aid without sacrificing national-forest work unduly.

The aerial photographic survey of southeastern Alaska was completed by the Alaskan aerial survey detachment, representing cooperation between the Navy, the Department of the Interior, and the Department of Agriculture. During the season 13,000 square miles were covered. The method consisted of dividing the region into suitably sized blocks and then gridironing each with airplane flights at an elevation of 10,900 feet. Thus a series of vertical photographs has been obtained, which furnishes new information on the topography and natural resources of the entire area of southeastern Alaska. The results are of special value to the Forest Service and the Federal Power Commission, since the Tongass National Forest has large bodies of timber and water-power resources awaiting development.

ROADS

Tables 21 to 25 show the forest road and trail situation at the close of the fiscal year. Three classes of construction are differentiated: Forest highways, which form part of the public road system and are of primary value for general public use; forest-development roads, of which the primary value is to provide the communication and transportation facilities necessary for the use, development, and protection of national-forest resources; and trails, which serve chiefly protection needs. All three classes coordinate in providing a comprehensive system of national-forest roads and trails requisite both for administration and for public convenience and local community development. For efficiency a due balance of the three classes is essential.

TABLE 21.—*Classification of mileage in forest road and trail system and expenditures required to complete system to satisfactory standard*

Class	Total	Satisfactory standard	Unsatisfactory standard	Non-existing	Expenditures required to complete
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Dollars</i>
Forest highways.....	16, 023	7, 307	7, 410	1, 306	166, 097, 400
Forest-development roads.....	51, 703	20, 048	14, 382	17, 273	60, 497, 200
Trails.....	149, 768	103, 489	9, 730	36, 549	5, 993, 600
Total.....					232, 588, 200

TABLE 22.—Construction, improvement, and maintenance of roads and trails from forest-road appropriations and other Federal and cooperative funds, by States June 30, 1930

State	Fiscal year 1930				Total constructed to June 30, 1930		Expenditure to June 30, 1930		
	Constructed		Maintained		Roads	Trails	Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails					
	Miles	Miles	Miles	Miles	Miles	Miles	Dollars	Dollars	Dollars
Alabama			111.5		102.5		100,912.03	25,278.16	126,190.19
Alaska	9.3	42.0	213.5	179.0	227.1	398.5	4,658,760.90	324,256.08	4,983,016.98
Arizona	180.9	58.0	1,220.5	1,069.5	1,522.3	1,641.0	5,510,128.46	864,100.40	6,374,228.86
Arkansas	59.0		247.0	150.0	476.5	518.9	1,070,608.02	29,638.14	1,100,246.16
California	515.3	447.0	4,120.2	6,795.8	2,544.9	3,546.6	13,546,717.93	5,259,499.07	18,806,217.00
Colorado	140.3	292.6	871.7	9,031.4	1,413.1	4,644.9	6,471,675.92	902,116.68	7,373,792.60
Florida	38.0		192.0		248.9		375,774.79	136,411.18	512,185.97
Georgia	9.9	22.0	142.0	190.6	71.5	212.6	412,562.46	53,819.64	466,382.10
Idaho	155.5	1,586.7	1,772.4	9,799.0	2,042.0	12,167.1	13,410,754.27	1,729,770.88	15,140,525.15
Illinois							420.57		420.57
Kansas					3.4		2,111.51		2,111.51
Kentucky							808.72		808.72
Maine		5.0	5.3	40.8	5.3	45.8	41,531.45		41,531.45
Maryland							70.05		70.05
Michigan	2.8		43.3		34.0		74,713.36	394.93	75,108.29
Minnesota	10.4	7.7	119.0	347.6	363.0	146.8	748,342.88	255,768.27	1,004,111.15
Montana	52.4	1,406.9	1,391.3	10,380.0	992.8	6,823.2	8,164,141.32	625,539.16	8,789,680.48
Nebraska	1.4		53.1		48.3		86,477.64	990.80	87,468.44
Nevada	24.6	22.6	189.3	86.0	454.1	853.6	1,376,581.49	153,574.55	1,530,156.04
New Hampshire	5.6	8.0	43.9	438.0	48.2	446.0	295,658.20	18,474.83	314,133.03
New Jersey							217.71		217.71
New Mexico	107.9	47.8	630.2	1,238.0	885.8	1,492.1	3,986,090.79	324,825.74	4,310,916.53
New York							81.32		81.32
North Carolina	9.2	8.5	182.2	596.2	205.7	613.0	679,883.44	62,857.41	742,740.85
North Dakota					1.0		57.75		57.75
Oklahoma			35.0		24.7	16.5	55,933.11	12,362.16	68,295.27
Oregon	230.0	868.9	5,416.4	10,096.5	3,028.6	6,979.7	12,448,808.55	5,958,014.12	18,406,822.67
Pennsylvania	.2		129.8		47.2		97,012.22	3,381.92	100,394.14
Porto Rico				36.0	4.6	36.3	18,127.41	550.00	18,677.41
South Carolina	1.0		17.9	4.0	17.3	18.2	97,755.73	15,659.81	113,415.54
South Dakota	14.6	10.0	142.3	28.6	287.3	71.7	805,238.54	222,846.11	1,028,084.65
Tennessee		38.0	63.8	542.9	93.1	574.9	395,848.80	136,369.34	532,218.14
Utah	39.9	143.8	682.5	931.7	1,066.3	3,448.3	3,377,621.44	787,778.56	4,165,400.00
Virginia	3.0	9.0	147.6	564.2	113.4	780.2	540,041.29	39,944.90	579,986.19
Washington	77.7	970.2	1,006.6	8,452.0	1,029.4	5,430.1	8,020,935.63	1,574,655.35	9,595,590.98
West Virginia	19.0	18.0	87.3	266.2	78.0	343.7	185,547.80	5,300.00	190,847.80
Wyoming	17.7	162.8	620.1	4,521.1	974.4	2,202.8	4,217,175.06	380,564.32	4,597,739.38
Total	1,725.6	6,175.5	19,897.7	65,785.1	18,454.7	53,452.5	91,275,128.54	19,904,742.51	111,179,871.07

TABLE 23.—Distribution among the States of the apportionments for the fiscal year 1931

State	10 per cent fund	Forest high-way fund	Forest-road development fund	Total
	Dollars	Dollars	Dollars	Dollars
Alabama	76.21	7,558	12,178	19,812.21
Alaska	11,030.75	969,811	18,992	999,833.75
Arizona	36,832.95	599,307	151,175	787,314.95
Arkansas	22,978.35	89,146	80,214	192,338.35
California	162,750.81	1,428,063	478,859	2,069,672.81
Colorado	56,496.96	692,324	117,253	866,073.96
Florida	4,592.59	28,572	14,581	47,745.59
Georgia	1,602.11	16,570	28,873	47,045.11
Idaho	66,208.48	1,036,524	659,903	1,762,635.48
Illinois		823		823.00
Maine	729.16	2,880	2,250	5,859.16
Michigan	738.04	14,820	7,181	22,739.04
Minnesota	4,936.02	63,078	14,780	82,794.02
Montana	30,477.55	837,355	251,377	1,119,209.55

TABLE 23.—*Distribution among the States of the apportionments for the fiscal year 1931—Continued*

State	10 per cent fund	Forest high-way fund	Forest-road development fund	Total
	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Nebraska.....	950.02	9,817	896	11,663.02
Nevada.....	10,500.19	198,858	14,539	223,897.19
New Hampshire.....	10,041.32	45,171	12,387	67,599.32
New Mexico.....	14,101.15	425,414	101,658	541,173.15
North Carolina.....	4,029.62	27,271	30,762	62,062.62
Oklahoma.....	844.03	4,176	2,703	7,723.03
Oregon.....	76,709.06	1,334,195	433,282	1,844,186.06
Pennsylvania.....	1,521.92	16,906	20,979	39,406.92
Porto Rico.....	65.91	1,123	1,180	2,368.91
South Carolina.....	596.17	3,184	1,857	5,637.17
South Dakota.....	17,679.06	83,581	12,131	113,391.06
Tennessee.....	1,386.87	25,175	23,717	50,278.87
Utah.....	23,122.47	350,105	54,053	427,280.47
Virginia.....	4,923.59	31,846	33,051	69,820.59
Washington.....	66,576.44	699,555	278,799	1,044,930.44
Vest Virginia.....	994.21	14,809	23,350	39,153.21
Wyoming.....	37,531.71	441,983	117,040	596,554.71
Total.....	671,023.72	9,500,000	3,000,000	13,171,023.72

TABLE 24.—*Distribution among the States of the total apportionments, including the fiscal year 1931*

State	10 per cent fund	Section 8 fund	Federal forest road construction	Forest high-ways	Forest road development	Total
	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alabama.....	884.22	15,456.04	1,922.31	35,369.00	68,113.00	121,744.57
Alaska.....	161,434.78	470,698.56	193,549.95	4,999,636.00	218,511.00	6,043,830.29
Arizona.....	606,189.43	680,092.81	501,984.55	3,035,843.00	1,349,332.00	6,173,441.79
Arkansas.....	122,305.46	174,939.40	128,773.38	392,693.00	488,432.00	1,307,143.24
California.....	1,516,831.67	1,466,656.22	1,206,815.23	7,349,937.00	4,042,207.00	15,582,447.12
Colorado.....	699,320.03	760,086.53	777,307.26	3,602,133.00	1,563,281.00	7,402,127.82
Florida.....	38,485.82	119,528.14	21,534.94	127,869.00	135,592.00	443,009.90
Georgia.....	11,349.52	52,393.57	134,387.16	88,303.00	171,309.00	457,742.25
Idaho.....	911,429.93	1,198,282.93	1,367,402.82	5,455,404.00	6,088,418.00	15,020,937.68
Illinois.....				2,379.00	396.00	2,775.00
Kansas.....	1,867.27					1,867.27
Kentucky.....	722.72				86.00	808.72
Maine.....	3,498.69	32.41	3,738.77	14,112.00	24,134.00	45,515.87
Maryland.....	70.05					70.05
Michigan.....	3,428.77	115.63	3,000.00	36,277.00	64,299.00	107,120.40
Minnesota.....	39,298.67	8,292.73	108,352.03	317,931.00	340,898.00	814,772.43
Montana.....	571,475.62	756,615.09	731,497.39	4,355,605.00	3,051,648.00	9,466,841.10
Nebraska.....	18,563.94	18.98		52,618.00	28,747.00	99,947.92
Nevada.....	167,880.26	195,073.18	82,265.33	1,037,786.00	132,424.00	1,615,428.77
New Hampshire.....	46,220.61	341.66	10,941.30	193,232.00	137,563.00	388,298.57
New Jersey.....	118.99				83.00	201.99
New Mexico.....	339,260.05	430,479.61	509,215.36	2,258,910.00	1,060,980.00	4,598,845.02
New York.....	4.00				20.00	24.00
North Carolina.....	35,813.77	84,733.83	176,890.28	142,577.00	285,928.00	725,942.88
North Dakota.....	45.75	7.00				52.75
Oklahoma.....	9,816.47	65.49	2,775.17	24,526.00	25,223.00	62,406.13
Oregon.....	986,004.95	1,431,759.62	1,077,552.29	6,395,826.00	4,430,743.00	14,321,885.86
Pennsylvania.....	3,393.75	24.04	21.42	46,918.00	90,766.00	141,123.21
Porto Rico.....	94.60	7.00	3,343.09	6,533.00	13,128.00	23,105.69
South Carolina.....	2,826.55	402.10	48,028.61	15,413.00	45,599.00	112,269.26
South Dakota.....	171,369.92	83,752.10	79,341.53	400,856.00	197,367.00	952,686.55
Tennessee.....	15,564.11	103,433.37	28,092.79	115,326.00	198,999.00	464,415.27
Utah.....	384,172.45	445,941.81	464,562.35	1,845,252.00	625,474.00	3,765,402.61
Virginia.....	43,739.90	58,390.16	71,902.26	158,810.00	278,393.00	611,235.32
Washington.....	614,436.90	939,812.13	712,201.40	3,571,967.00	3,134,615.00	8,973,032.43
Vest Virginia.....	5,796.79	12,830.41	5,049.24	55,620.00	149,865.00	229,161.44
Wyoming.....	417,318.40	472,109.76	547,551.79	2,364,339.00	1,057,427.00	4,858,745.95
Undistributed.....		37,627.69				37,627.69
Total.....	7,954,034.81	10,000,000.00	9,000,000.00	48,500,000.00	29,500,000.00	104,954,034.81

TABLE 25.—*Condition of forest-road funds on June 30, 1930*

Fund	Appropriations	Expenditures	Unexpended balance
10 per cent.....	\$7,283,011.09	\$6,836,337.65	\$446,673.44
Sec. 8.....	10,000,000.00	9,917,125.58	82,874.42
Federal forest-road construction.....	9,000,000.00	9,000,000.00	
Forest highway.....	39,000,000.00	37,233,992.69	1,766,007.31
Forest road development.....	26,500,000.00	26,134,739.33	365,260.67
Total.....	91,783,011.09	89,122,195.25	2,660,815.83

In addition to the regulation trail, for which definite standards of width, permissible grade, and other structural features have been established, simpler pathways, commonly designated "ways," have recently become a recognized part of the protective roads system.

Road funds are partly Federal, partly cooperative. Of the Federal funds the principal part is provided by specific acts of Congress making appropriations for nation-wide road development. There is also, under a continuing provision of law, the so-called "10 per cent fund," comprising 10 per cent of the national-forest receipts for the preceding year.

The Federal legislation for a program of nation-wide road development has recognized a need for special provisions relating to national-forest roads, along two distinct lines. Because the national forests withhold from taxation extensive land areas and resources, a counterbalancing increase of appropriations for development of those portions of the general public road system traversing the forests has become customary; and in addition the appropriation acts have carried a separate item for the construction and maintenance of the supplementing forest-development road and trail system.

The act of June 24, 1930, for national-forest roads and trails raised the appropriation authorization for the fiscal year 1931 from \$7,500,000 previously authorized to \$12,500,000 and set up this authorization for the years 1932 and 1933. Under the earlier legislation the \$7,500,000 was divided on a 60-40 ratio between the forest highway system and the forest-development road system. Under the provisions of the new law, however, all the \$5,000,000 increase will be added to the former provision of \$4,500,000 for national-forest roads embraced in the forest highway system, leaving unaltered the \$3,000,000 previously provided for forest-development roads. While this will decidedly speed up the rate of progress toward completion of the forest highway system, it leaves the roads of the second class less well provided for. These roads are of decided value to the local public and an indispensable tool for efficient protection, administration, and development of the forest resources.

The act of June 24, 1930, prescribed as conditions to the expenditure of more than \$7,500,000 under the 1931, 1932, and 1933 authorizations: (1) That the Secretary of Agriculture shall give preference to projects which he shall determine are not otherwise satisfactorily financed or provided for, located on the Federal-highway system as now or hereafter designated; (2) that the projects so preferred shall be constructed of the same width and character as the Federal Government requires of the States under like conditions; and (3) that the Secretary of Agriculture shall prepare, publish, and distribute a

map and other information, at least annually, showing the progress made in the expenditure of the amounts exceeding \$7,500,000.

In last year's report mention was made of a new method of determining the most advantageous and economical transportation system required for protection. During the year the planning of the systems for several individual forests was undertaken, and within four years the completion of such plans for all forests where they are called for is contemplated. The objective is to enable fire fighters to reach any fire within a certain time, this time being determined by the value of the resources exposed to fire damage, the degree of hazard, and the consequent rapidity of action deemed necessary to hold losses inside a specified limit.

It is recognized that the complete prevention of fire damage is impossible. Many fires will start and will cover at least some ground before they can be discovered, reported, and extinguished. Other things being equal, the area covered will depend upon how quickly an adequate force of fire fighters with adequate equipment can reach them. The importance of prompt control, however, varies both with the value of the resources exposed to fire damage and with the degree of exposure. A rational system of protection must take these variables into account in setting up standards of satisfactory performance or objectives. Once this objective is established the transportation system can be planned with a view to obtaining at the least annual expense, the prescribed degree of promptness of control and the number and location of the protective force required to make possible reaching, in the allowable travel time, a fire anywhere within the protection unit for which the plan is made.

The first dependence for fire suppression is the "smoke chaser," or the single-man outfit, highly mobile and prepared to start instantly on receipt of the alarm. When 1-man control is judged to be improbable or proves to be impossible, larger crews must be gathered and dispatched. The planned system must meet the travel-time requirements of both "first-line defense" and "second-line defense." Usually there are several possible arrangements of roads, trails, ways, and men that will satisfy the specific requirements laid down—for example, a large number of smoke chasers, practically no roads, and not many trails and ways; or fewer men, a large mileage of trails and ways, and a small mileage of roads; or a few widely scattered smoke chasers, a comparatively small mileage of trails and ways, and a large mileage of roads, some of high duty. To determine which system will give the desired results at the least annual cost requires careful study. Annual cost is the cost of maintenance plus an interest allowance on the expenditure for construction. It is usually necessary to design for the second-line defense and modify or add to meet the requirements for first-line defense.

Where portions of the area can be reached within the prescribed travel time from two or more stations, the annual cost of the system is raised. If reaching all parts of the area in the specified time involves—as is nearly always the case—such overlapping, the question arises whether the cost of the overlap is justified, or whether part of the area should have less protection.

Developing a transportation plan is costly in time, including much field work, but when completed these plans promise to have great value. By indicating the required organization and its location they

will show where buildings, telephone lines, and other improvement of an administrative and protective nature should be placed. They will also help determine the best layout of ranger districts and will afford a guide to the most effective use of road and trail appropriations through orderly construction based on recognition of the relative importance of projects. Still more important, before the construction of a road or trail is begun the duty or service which it must render to fulfill the protection objective will be definitely known. If a road is needed on which 30 miles can be traveled in two hours the transportation planning provides one requiring neither more time nor less, unless one requiring less time can be constructed without augmenting annual costs.

The same type of construction will not always provide the same travel rate, nor cost the same, either for construction or annually. On the contrary, the cost of securing a desired speed varies greatly. Under favorable conditions it may be only a fraction of that under unfavorable. To design a road that will make available the desired speed at the lowest annual cost, knowledge is needed of the speed obtainable with various combinations of the several elements that make up a road standard. To secure the required data necessitates setting up special tests. The effect of banking and curvature on speed of travel has been determined, and partial data have been secured on the effect of gradient and surface condition.

MAPS AND SURVEYS

The Forest Service published during the year for administrative use 13 national-forest maps on a scale of one-fourth inch to the mile, 12 on a scale of one-half inch to the mile, of which 3 were lithographed in several colors; and 3 on the scale of 1 inch to the mile, of which 1 was an atlas folio. Three administrative maps on odd scales were published and 10 proclamation diagrams were issued in cooperation with the Department of State.

Twenty-one maps of forests, 77 atlas pages, and 1 atlas page showing culture, drainage, and contours were compiled, revised, or traced. 2,030 type maps and atlas pages were colored; and 368 graphs showing research data were compiled. In addition, numerous posters, ranger maps, status and ownership maps, organization charts, working circle maps, recreation or folder maps, index maps, road signs and maps, mechanical drawings, panels for exhibition purposes, etc., were prepared by the draftsmen.

Topographic and drainage surveys of considerable areas were made upon the Kootenai, Shasta, Powell, Boise, and Dixie Forests. Topographic surveys were also made of many small timber, grazing, and land-exchange areas.

The General Land Office initiated original surveys within the national forests on 43 townships and completed the survey upon 36. Resurveys were initiated upon 20 townships; and surveys, some of which had been started during the previous year, were completed upon 23. The total area which was surveyed or resurveyed amounted to approximately 900,000 acres.

The Geological Survey surveyed approximately 2,100 square miles of national-forest land.

The photographic laboratory turned out 5,911 lantern slides, 92,781 square feet of Van Dyke photostats, blue prints, and solar bromides, and 5,515 square feet of wet plates; mounted 314,500 square feet of maps and 3,365 photos; developed 6,459 films; made 88,320 photo view prints and 51,694 prints of aerial photographs of Alaska; and enlarged 3,762 photo views. This was an exceptionally large volume of photographic work.

RESEARCH

Last year's report pointed out the necessity for a well-rounded, coordinated research attack upon the many-sided, complex forest problem of the country. It was explained that the system of regional forest experiment stations being developed by the Forest Service, with fresh stimulus from the McSweeney-McNary forest research act, is providing a means of bringing together and correlating on a regional basis investigations in forest and range management, forest products, forest economics, and erosion. The year's experience strengthens the conviction that this regional and subjective correlation will afford the best line of attack by research on the forest problem as a whole.

The possibilities of coordinated research are illustrated by the logging and milling studies, of which details are given later. In those studies the divisions investigating forest products, economics, and silviculture made a correlated attack upon the same problem. In California, for example, a comprehensive logging and milling investigation, which started with the trees in the woods and took them through the mill to the finished product, brought out the economic results of varied silvicultural practices, as well as of the costs and returns from utilizing logs and trees of different sizes and qualities. The study included the economic influence of insects and disease and will include the relation of these agencies, as well as wild life, to the growth and reproduction of the subsequent stand. Similar studies in the South gave special attention to the influence of growth conditions upon density and the properties of the wood. In the investigation of naval stores the forest products and management divisions have been making a combined study of conservative methods of turpentine. Coordination of range management and erosion studies has facilitated the development of principles and practices in the intermountain region and in the Southwest.

The regional stations are greatly facilitating the development and expansion of a sound program of forest economic research. Under the stations this work is being regionalized and coordinated with research in all other lines. Forest economics involves largely studies of the application of the results of other research, investigations of regional forest resources and economic relationships, and the formulation of principles for application over broad ranges of conditions. These principles form the basis for public and industrial policies affecting forests and forest land.

The nation-wide forest survey, an undertaking of first importance, is being organized and prosecuted intensively as part of the station programs on a much more constructive basis than would be practicable otherwise.

The stations supply the needed facilities for coordination of regional research in forest entomology, forest pathology, forest biology, and, in short, for the entire forest research of the Department of Agriculture. At many of the stations representatives of other bureaus work in close association with the Forest Service organization. During the year a forest biologist was assigned to the Appalachian station and one to the Lake States station.

Furthermore, the stations furnish the nucleus for a concerted attack upon regional forest problems by State and private organizations. In practically every region, and at the Forest Products Laboratory close cooperation has been effected between the Forest Service on the one hand and the State foresters, forest schools, State agricultural colleges, and State experiment stations on the other. In California counties and municipalities also are actively participating in the conduct of forest research. Lumber and pulp manufacturing organizations and associations, other industries, livestock producers, water users, and scientific bodies are likewise cooperating.

During the year one new forest and range experiment station, the Intermountain, covering Utah, Nevada, and southern Idaho, was formally organized on a regional basis, with headquarters at Ogden. This station, which absorbs the Great Basin range station, and for which increased funds were provided by Congress, now brings together on an expanded basis studies of the range, erosion, and silviculture.

Stimulus was given to the establishment within the national forests of a comprehensive system of experimental forests and ranges, the purpose of which is to make permanently available for silvicultural, range, products, and other related forest research carefully selected representative areas large enough to meet expressed and foreseeable future needs. In essence these areas are field laboratories. In the interest of most effective accomplishment, the work of the forest and range experiment stations will be concentrated as fully as possible upon them. Most of these experimental forests will vary from 1,000 to 3,500 acres in area. Eight forests have now been established—the Priest River Forest in northern Idaho, the Fort Valley in northern Arizona, the Bent creek near Asheville, N. C., the Gale River and Bartlett Forests in the White Mountains of New Hampshire, the Fremont in Colorado, the Bernice in Montana, and the Upper Peninsula in Michigan; also two experimental ranges—the Santa Rita Range in Arizona and the Jornada in New Mexico. The expansion of this system is being aggressively pushed as a fundamental basis for the effectiveness of the regional work.

Emphasis is also being placed upon the establishment of natural areas. The purpose is to preserve permanently and in an unmodified condition areas representative of the virgin growth of each forest or range type within each forest region, to the end that the characteristic plant and animal life and soil conditions shall continue to be available for the purposes of science, research, and education.

Funds made available for research activities under various appropriation items for the fiscal year 1930 are compared with the amounts for 1929 and 1931 in Table 26.

TABLE 26.—*Appropriations for research for 1930 as compared with those for 1929 and 1931*

Class of research	Appropriations for fiscal year—		
	1929, directly appropriated ¹	1930, directly appropriated	1931, directly appropriated
Forest management investigations.....	\$377,407	\$413,000	\$488,500
Forest-products investigations.....	542,596	585,000	635,000
Range investigations.....	52,680	67,000	85,000
Forest economic studies.....		25,000	50,000
Forest survey.....		40,000	125,000
Forest-taxation study.....	63,640	65,000	70,000
Forest-insurance study.....		10,000	10,000
Erosion-streamflow studies.....		30,000	30,000

¹ Includes Welch Act increases.

FOREST ECONOMIC INVESTIGATIONS

The investigation of the financial aspects of private forestry practice, one of the major and fundamental economic projects authorized by the McSweeney Act, was organized and field work was begun. This is the first comprehensive appraisal ever undertaken on a nationwide scale of the costs of and revenues from private forestry. It is a constructive determination of the natural conditions, silvicultural methods, and other factors making it possible to grow timber at a profit. The southern pine region, because of its enormous productive capacity and broad economic importance, was selected as the first for intensive work. A thorough study of conditions on the ground was made for six counties, scattered through several States and carefully selected to typify representative conditions. These were intensively studied as to their forest resources, the existing practices of land management, utilization, and marketing, and as to forest growth conditions. A careful analysis is being made of the present and potential financial returns from the integrated use of forests for naval stores, lumber production, and for other purposes. Progress reports are in various stages of completion for these counties, which will make the information available to local forest-land owners and operators and will lay a foundation for the comprehensive conclusions of the study for the region. The county studies have clearly shown that under many conditions forestry will give a reasonable return on the money invested and that there is great opportunity for the adoption of improved methods and efficient integration of forest uses. Indications are that for many sections the maintenance of a reasonably prosperous local economy depends upon the wise use of a large portion of the land for forest purposes.

A forest-insurance study was organized as part of the program of the Pacific Northwest Forest Experiment Station, to appraise the possibilities and formulate principles of fire insurance as an aid to private forestry. The year was devoted to an exploratory study of the literature and experience at home and abroad, to establishing advisory and cooperative contacts, and to preparing plans for the more intensive work.

The results of a study of land utilization in central West Virginia, made in cooperation with the Bureau of Agricultural Economics,

were analyzed and prepared for publication. These show that large areas in the mountainous sections hitherto used for crops are clearly submarginal for such use and are well suited for growing timber. Forest lands under prevailing practices are producing only a small fraction of what they might under better methods. Farm wood lands can be made a much more important factor in the farm economy of the region than they are now, and together with other second growth timber tracts can maintain local wood-using industries which themselves, provide important markets for labor and farm products.

Cooperation was continued with the Bureau of the Census in the collection of the lumber-production statistics for 1929 in the 12 Western States, which include nearly half of the entire lumber cut of the country. The Forest Service also biennially makes a questionnaire canvass of lumber distribution. Through the cooperation of the Canadian Government statistics of lumber distribution between the individual States of the United States on the one hand and the individual Canadian Provinces on the other hand were made up for the first time. This gave a much more comprehensive picture than was ever available before of the quantities and sources of lumber consumed in the United States and Canada.

FOREST SURVEY

Initial plans were made and field work was begun on the nationwide forest survey. This survey, authorized by the McSweeney Act, is to be a comprehensive appraisal of the Nation's present and future requirements for forest products, the present and potential forest growth, existing volumes and qualities of timber, the areas and conditions of forest lands, and other facts needed as a basis for balancing the timber budget. It is one of the most important and far-reaching undertakings ever launched by the Forest Service. It is fundamental to forestry and of national significance.

The survey will be prosecuted, particularly the resource inventory and growth phases, by special staffs added to the regional stations. Work on a comprehensive basis will be restricted to a few regions at a time, and the detailed and essential facts as to the forest conditions for each region will be made available as rapidly as possible in advance of the completion of the survey for the country as a whole. These facts will constitute a reliable and greatly needed foundation for the development of local industrial and public programs.

The Douglas fir region was selected as the first for intensive field work. Plans were prepared, the technical staff was organized for work outside the national forests, cooperation was arranged with the administrative organization to cover the national forests themselves, and cooperative contacts and arrangements were made with many other agencies. Field work was commenced on a considerable scale on the physical-resource inventory—that phase which will be the most time-consuming and expensive.

Cooperative work was commenced in the Lake States, under the Lake States station, to supplement the three State land-economic inventory projects with such additional information on the forest resources as is needed to make these local undertakings of full value to the forest survey itself.

The data secured in the statistical canvass of the wood requirements of the secondary wood-using industries for 1928 were compiled

into three United States tables, showing the quantities used by the 60 classes of manufacture, by kinds of wood and by States, and the results were made currently available in progress-report form for State foresters and industrial and other agencies. Compilations are also completed and will appear in similar form, showing the situation in considerably more detail by States. This canvass and the compilations constitute only one step in the investigation of the Nation's needs for wood and for forests—one of the major phases of the forest survey, and one which bears directly upon land use.

Substantial progress was made in formulating the intricate and detailed plans for handling the resource-inventory phase of the survey, not only for the Douglas-fir region, but also with necessary correlation for all regions. Much work still remains to be done in the formulation of plans as the growth, drain, and requirements phases of the survey are taken up in more detail. Funds have been made available for the expansion of the work in the Douglas-fir region during the present year, for the initiation of intensive work in the southern Mississippi hardwoods, and for vegetative type-map work in California.

FOREST TAXATION

Effort was mainly devoted to the analysis of data already collected. At the same time field work was undertaken in North Carolina, and the collection of data for two of the three counties selected for special study was in large part completed. This will be one of the States to be intensively studied as a sample of regional conditions.

The office study of European tax conditions affecting forestry was advanced by material collected in France, Switzerland, and Germany by a well-qualified expert in European taxation and by a very careful office analysis of forest-tax legislation and conditions in Norway and Sweden.

A study of the effects of existing forest-tax legislation in the United States was initiated. This study had been left to the later stages of the general investigation so as to secure results based upon the longest possible experience with the more recent laws.

Four progress reports were issued, entitled "The Forest Counties of Minnesota: Tax Base (continued), Tax Rates, and Tax Burden on Wild Land," "Assessment Ratios of Rural Real Estate in Oregon and Washington," "Digest of State Forest Tax Laws Enacted or Revised During the Calendar Year 1929," and "Methods of Research in Forest Taxation." There was also made available in multigraph form a preliminary set of tables relating to forest taxation in New Hampshire. These reports serve to make the most important factual information currently available and useful, not only to the staff of the inquiry, but also to State and other agencies concerned in problems of taxation and public finance from the forestry and related viewpoints.

FOREST MANAGEMENT AND PROTECTION INVESTIGATIONS

Research in forest management seeks the facts that must be known in order fully to utilize the many and diverse forest types and soils of the country. The field is broad. It covers all that affects or determines forest growth from seed to harvest, and also the effects of the forest upon climate, stream flow, and erosion.

At the Pacific Northwest Forest Experiment Station a study was made of methods to obtain prompt and adequate new growth when the virgin stands are cut. The common logging practice in the region is to cut the forest practically clean and to burn the slash broadcast. Seed for restocking must come largely from adjacent timber and from such scattered and usually worthless individual trees as may be left. Adjacent timber, however, may soon disappear before the advancing lumbering operation, and the scattered individual trees may not long survive. It is important to know how far and in what quantity seed is distributed and what conditions favor or interfere with its germination and with seedling survival.

Seed dispersal was studied by liberating seed at different heights and wind velocities. While seed released in a low wind at a height of 200 feet fell in quantity up to 1,200 feet away, and in a very high wind some seed traveled as far as half a mile, under natural conditions in a light seed year no seed was obtained more than 500 feet from the seed trees. On soil blackened by a slash fire, surface soil temperatures were found to reach 144° F., sufficient to kill Douglas-fir seedlings. This points to the need for giving careful attention to the number, distribution, and location of seed trees for the sake of shade as well as for effective seed distribution, and also raises questions regarding the use of fire on cut-over areas.

In regions where most of the virgin timber has been removed the principal center about which the individual studies group is the conversion of a greatly deteriorated forest into one of good possibilities. For example, in the Lake States very extensive stands of jack pine, aspen, birch, and scrub oak have succeeded most of the valuable virgin white and Norway pine. The jack pine and aspen can be used for pulp, but as yet the birch and stunted oaks have little value. It would take centuries for unaided nature to rehabilitate these areas with a valuable forest. The Lake States Forest Experiment Station is now giving particular attention to conversion measures. Preliminary results of such experiments in the scrub oak lands of northern Michigan and in the aspen-birch lands of Minnesota have been published. A somewhat similar problem in the northeastern spruce region concerns holding in check fast-growing but undesirable hardwoods which invade cut-over areas and prevent or retard the further development of young spruce already on the ground. By cutting back some of this inferior growth at the proper time during the first few years the spruce can be encouraged at a cost sufficiently low to make this practice feasible. The results of similar experiments in the southern Appalachian region show equal encouragement for the continued production of the valuable yellow poplar by removing the competing sumac and silverbell, neither of which has commercial value.

Successful reforestation calls for planting stock grown from sound, healthy seed produced by thrifty, straight-growing parent trees under climatic conditions similar to those of the site where the planting is to take place. Studies of Norway pine seed at the Lake States Forest Experiment Station emphasized the danger of frost damage or failure due to droughts before the planted tree reaches maturity if the seed came from an unlike climatic zone.

Studies at the Lake States station indicate that the slowness of germination of white pine seed in the nursery, which has stood in the way of effective practice, can be overcome by simulating natural conditions. Prompt germination was obtained by mixing the seed with moist sand or sawdust and storing in a cold cellar for from two to four weeks before spring sowing time. This gave all the advantages of fall sowing without the danger of rodent losses. That low temperatures tend to increase the percentage of germination of stored seed has been found to be true of species with such different characteristics as the northern white pine and the southern longleaf pine. Because of the rapid rate of deterioration it has rarely been possible to store longleaf seed more than one year. The Southern Forest Experiment Station has discovered that storage at low temperatures apparently not only lengthens the period of vitality but actually increases the germination percentage.

The establishment of what may be termed a seed-control station at the Lake States Forest Experiment Station, in cooperation with the College of Agriculture of the University of Minnesota, permitted the inauguration of a seed-testing service to the various forest agencies of the region, and insures uniform tests year after year of the seeds used in all research activities. Some 200 germination tests have been made since the equipment was installed.

Naval-stores research continues to strengthen the case for conservative methods of working pine timber. Proof that trees less than 9 inches in breast-high diameter are operated at a loss has led the factorage houses to stipulate in this year's contracts that no smaller trees shall be worked. The development of a new chipping tool opens the way for further improvement. With it a small, narrow face is made, similar to the French face, and yields are obtained which compare favorably with those obtained when the American hack is used. The new tool, in contrast to that used in France, can be used readily by the local woods labor, overcoming one big obstacle to the adoption of the French type of face.

Other results relate to the need for better judgment regarding what trees are to be worked and where the face is located. Operators suffer a considerable loss by facing low-yielding trees or by putting faces on the wrong side of trees. Great differences have been found to exist in the yield on different sides of the same tree. Trees with one-sided crowns produce more resin on the side with the largest branches, and faces placed above old fire scars produce little resin. Operators could make further savings by varying their working in accordance with seasonal conditions. In hot, dry summers trees chipped twice a week will supply good yields of a high grade of resin without injury, while during a rainy summer even one chipping a week may not pay. In the cold fall or early spring frequent chipping does not stimulate the resin flow, which continues for from 10 days to 2 weeks after chipping.

Forest-fire control continues to be one of the most difficult and pressing of all American forestry problems, and more research in every region is urgently needed. Further detailed analysis of the records of past fires by the regional forester of the California National Forest region and the director of the California Forest Experiment Station afforded the most outstanding contribution of the

year to the solution of the fire problem. This continued earlier studies by the same men on the very direct interrelationship between cover type, fire hazard, and fire control. A publication recording the results of these further studies was prepared, and has appeared since the close of the year. It was shown that fires must be caught within a time varying with the different types of forest cover, the degree of risk, the amount of fuel, and the accessibility in order to control them while they are still small. The desired "hour control," or degree of protection which it is feasible to undertake, is applied by devising a correlated detection and suppression system, including means of communication and travel, that will insure the presence of a force of fire fighters of specified size and equipment anywhere within a specified time after a fire starts. Increased funds made available for fire research in the coming year will be expended in carrying these California studies further. One of the aims will be, by applying intensively the results of previous research on a single forest, to discover what additional protection features are necessary to make a large unit practically safe from fire. There is great need for similar statistical studies of past fire records in other regions.

Since lightning is the principal cause of fires in the West, much attention has been directed to the lightning hazard, and hundreds of lookouts now record facts concerning lightning storms. In the northern Rocky Mountain region more than 15,000 reports have been made on these storms in the past five years. Many of these storms have never been recorded by the regular Weather Bureau stations in the agricultural valleys. Analysis of these lightning-storm records by the Northern Rocky Mountain Forest Experiment Station has permitted a more accurate classification of the lightning hazard on various forest areas. It has also shown that certain types of storms are more dangerous than others, and warnings can be given of their approach, enabling the fire-control forces to make preparations for meeting the special hazard.

Through analysis of the 5-year records of a forest-fire weather station in the spruce-hardwoods type in the Adirondacks the relationship between weather and forest fires was studied from the standpoint of the effect of each weather element upon the various fuels present in the forest. For the dense forest six degrees of hazard, from generally safe to extremely dangerous, were recognized. Separate hazard tables were prepared for cut-over lands, where the fuels respond more quickly to changes in weather conditions. Similar fire-weather stations have been maintained cooperatively in the Northeast in the spruce slope type of eastern New York, the white pine type of Massachusetts, and the spruce type of northern Maine.

To carry the study of forest inflammability one step further, an experimental fire forest has been established by the Lake States Forest Experiment Station in cooperation with the Michigan Department of Conservation, where will be determined the effect of such factors as temperature, humidity, and wind velocity upon the ease with which fires will start in different fuels, and upon their rate of spread. Tests of fire-fighting equipment and of fire-fighting methods will serve to demonstrate how best to control fire under varied weather and fuel conditions at different times of the year.

EROSION-STREAMFLOW INVESTIGATIONS

To determine the part that forests play in the control of erosion under varying local conditions, existing studies were amplified and new ones were initiated. Two are of particular note. In the regions where they are conducted erosion contributes heavy burdens of silt to the Mississippi River. One concerns the easily eroded fine silt loam uplands east of the lower Mississippi River.

The soil is sometimes 75 feet deep. A survey of several counties revealed that from 0.3 to 8.3 per cent of the cleared land was actively eroding. Land was found which in 20 years had made the complete cycle from forest through cultivation to abandonment. Forestry control measures are being developed to prevent further soil loss on areas permanently wrecked for agriculture.

Erosion is critical in southwestern Wisconsin also. Measurements of silt caught in silt traps indicated that forests are the form of vegetative cover most effective in holding the soil. Hay lands when in good condition hold soil nearly as well, but more rain runs off. Bluegrass pastures with unbroken sod hold the soil firmly, but when they are closely grazed gullies are apt to form. Closely grazed pastures are very ineffective in retaining water and deliver almost all of it to places where erosion may occur. Cultivated fields erode badly, especially where cultivation does not follow the contours. To control erosion contour-plowing, terracing, the construction of dams in gullies, and the diversion of water above the fields are suggested. Keeping land in forest immediately above cultivated fields is an effective farm-management measure.

Fifteen years' measurements and observations in Utah have shown how the restoration and proper grazing of high mountain ranges lessens surface run-off, soil erosion, and the intensity of summer floods. Increasing the herbaceous vegetation approximately two and one-half times had little if any effect on surface run-off from melting snow, but the burden of sediment in this run-off was reduced 57 per cent. Run-off from summer rains, which even under the depleted plant cover furnished only 5 per cent of the yearly surface run-off but carried 85 per cent of the eroded material, was cut more than half by the increase in vegetation, as was also the soil erosion due to them. A good herbaceous plant cover usually will not prevent flash summer floods from sudden heavy rainstorms in mountainous regions similar to those studied, but to a considerable degree will check torrential run-off and reduce floods. Because of the small portion that summer rainfall run-off makes up of the total annual surface run-off, any reduction in the summer surface run-off has no appreciable effect on the annual water supply. The maintenance of a good plant cover on the watersheds, by reducing the destructiveness of soil erosion and of summer flash floods, leaves the watercourses in a condition in which they can carry off the heavy spring flood from melting snow without destructiveness. A manuscript setting forth these findings was prepared for publication.

Preliminary studies were started on the Boise River watershed in southern Idaho during the year and produced the following interesting results: (1) There appears to be a definite relationship between quantity of precipitation and quantity of total stream flow over

periods of years, although individual years may show remarkable variation. (2) The average date when the stream flow of the Boise River has fallen below an amount required to prevent drawing on reservoir storage has been June 23 during the 10 years starting in 1920, as compared to June 29 during the 24 years 1895 to 1919. (3) Averaging the flow of the Boise River for 10-day intervals by 5-year periods shows prior to 1915 an average date of peak flow between June 1 and June 10, while since 1915 the average date has been between May 11 and May 20. (4) Recent serious erosion is associated with depletion of the natural plant cover by overgrazing, trampling by livestock, drought, rodents, and fire. The situation is of so critical a nature that it justifies far more intensive study than can be made with present funds.

General studies of the relation of semidesert brush and herbaceous plant cover to erosion on the Roosevelt Reservoir watershed in Arizona established the fact that, under the conditions there found, shrubs or trees must have sufficient density for the ground surface to be controlled by litter, or must be supplemented by herbs, in order to prevent erosion effectively. Otherwise soil depletion is a constant process, at first between shrubs and trees and later under their crown spread. Areas within the semidesert brush zones where grasses have not been depleted do not show evidence of abnormal erosion. An area of approximately 60 acres, with rather steep slopes, that has been protected in part for 20 years, has revegetated to grasses and other herbs until they now occupy 35 per cent of the ground surface and the sediment carried by run-off is so slight it could not be measured. The common practice in the region, however, has been to graze much of the range yearlong with such numbers of livestock that the grass growth is completely utilized long before a new supply becomes available. The stock then have to be maintained on brush until new grass growth appears. Consequently, following each year or cycle which does not receive rainfall in quantity or character favorable to the growth of grass, the grass density very rapidly declines. In the absence of grass the fine surface soil that was built up by and supported grass washes away readily. One 60-acre area with a 7° slope had over 2,000 cubic feet of soil eroded from it in less than two years. Another area with a steep slope lost an average of one-half inch of soil in less than a year. A vast amount of material has accumulated recently in small and large drainage lines, ready for transportation to the main river or the reservoir during the next period of excessive precipitation. The last 10 years have been deficient in precipitation. The very marked shortage of water supply and the extreme erosion occurring over a large part of the watershed demand an intensive study to determine what plant cover encourages the maximum of storage water with the least silting of reservoirs and how this cover may be restored and maintained under the periodic droughts which prevail in the region.

FOREST-PRODUCTS INVESTIGATIONS

Wood is both a raw material and a storehouse of raw materials. It contains cellulose, lignin, pentosans, and extractives, combined in variable quantities and arranged in a complicated and variable microscopic structure. The chemical composition of wood substance,

the arrangement of constituent parts in the wood cell, the size and spacing of the cells, and the variation of all such characteristics according to species and growth conditions determine the usefulness of wood, whether as wood or as something else. A scientific understanding of these matters opens the way to success in the silvicultural control of the material and its properties, in its selection, its seasoning and handling, its impregnation with preservatives, its use in construction, its conversion into pulp and other products—in short, affords the only means by which our national economic requirements and our forest land can be brought into the most serviceable adjustments with each other.

GROWTH, COMPOSITION, AND CHARACTERISTICS OF WOOD

Research is making clear the principles whereby the forester can predict and control wood quality by the conditions under which the tree is grown. For example, tests conducted for the last three years by the Forest Products Laboratory in cooperation with the Southern Forest Experiment Station have shown that for southern pine a moist site, protection from fire, and relatively close stands of trees produce dense, strong wood. Soil fertilization is less important than water supply. For a rapid production of lightweight wood of moderate strength the main requirements are fire protection and open spacing in the stand. Specimens of second-growth Douglas fir were found to be of lower density and less strength, on the average, than virgin-growth material—an illustration of the frequent effect of wild-land conditions on second growth and of the need for careful silviculture if the most satisfactory timber crop is to be obtained. In contrast to the conifers, hardwoods produce their strongest material when sustained or increasingly rapid growth occurs in open lands or as the result of thinnings. These and related data on the control of wood quality, accumulated over a period of years, were published during the year in a technical bulletin.

Factors of growth can now be taken into account in setting a commercial value for pulping purposes on stands of spruce, hemlock, aspen, birch, jack pine, southern pines, and about 15 other well-known or potentially useful pulp-wood species. Of special interest from the silvicultural point of view was the evaluation of a 37-year-old planted stand of Norway spruce in Wisconsin, in which dominant and suppressed trees were found equally good for conversion into sulphite pulp. The value set on this wood was \$11 per cord, or \$77.50 per acre, delivered at the mill. The new method of evaluation, developed this year and correlated with the results of pulping trials, is largely a process of sampling and chemical and physical testing. It is rapid and simple as compared to pulping trials and would aid both the marketing and the growing of pulp wood.

Additional data were obtained on the relations between wood structure, growth conditions, and such variables as longitudinal shrinkage, harshness, plasticity, and the formation of compression wood. The general objective of these studies is the detection of abnormal or inferior material and its causes, and their abatement through silvicultural control. A limited number of measurements showed that the

longitudinal shrinkage of redwood varied inversely with the density, not directly as is the rule for transverse shrinkage. Excessive longitudinal shrinkage was found to be a characteristic of very rapidly grown loblolly pine and redwood, entailing a serious handicap in use. Compression wood, recognized as a source of abnormal lengthwise shrinkage in softwood lumber, was found to be somewhat stronger than normal wood when green, but the advantage disappeared upon air-drying. A tendency was noted for compression wood to increase in amount with the lean of a tree from the verticle and with accelerated growth rate. The species included in the year study were western and southern yellow pines, Douglas fir, redwood and white fir. Mill studies of white fir revealed compression wood in about 8 per cent of the pieces of lumber examined, only a small part of which was of the pronounced type, a fact confirming the belief that this defect is a no greater problem in white fir than in other important species.

New applications of scientific method during the year gave a close view of wood structure and substance than has ever before been obtained. Units that may be the smallest physical aggregates of the wood cell were observed under the microscope. These are minute subdivisions of the "fusiform bodies," which make up the fibrils which in turn unite to form the cell walls of wood fiber. Beyond the power of the microscope the X ray was used to examine the physical orientation of molecules in the wood structure. Preliminary experiments, conducted in cooperation with the University of Illinois, indicated that wood cellulose consists of molecular chains regularly arranged in a pattern which is modified according to the species and condition of the material. Compression wood gave a distinctive picture which may be an effect of the slope of fibrils previously noted in the cell walls. On further development the X-ray method should afford a powerful means of determining and explaining differences between wood species, as well as between light and dense and wet and dry material.

From new electrical conduction tests it was concluded that the open area effective for the passage of liquids through and between the cells of Sitka spruce heartwood is approximately one-thousandth of the total cross section of the piece. Other woods will be similarly tested and the results checked by drying constants in the effort to arrive at a clearer view of wood structure and its mechanism in seasoning and impregnation processes.

CHEMISTRY OF WOOD

New values for forest thinnings, unused species, and logging wastes will accrue when industry is able to take miscellaneous wood material and transform it into useful products in greater variety and on a larger scale than has yet been attained. The possibilities in this direction are indicated by the already huge output of such technical products of wood as pulp, paper, rayon, viscose, and lacquers; but the development of new and improved products and their commercialization is ultimately dependent not on chance discoveries but on the results of scientific research, seeking always a clearer knowledge of the material and its chemical relationships. This principal holds

good throughout modern industry; it applies to wood no less than to metals, oils, foodstuffs, dyes, rubber, and textiles.

Significant progress was made in this year's study of wood cellulose. Research conducted by a member of the laboratory on furough at the University of Upsala, Sweden, resulted in the first recorded determination of molecular particle sizes of pure cotton and wood celluloses in solution. A new scientific instrument, the ultracentrifuge, was used. Particles of the same size as those in cotton were found in wood cellulose, together with other particles in a definite series of fractional sizes. This is an approach to solution of the problem of the molecular weight of cellulose, definite knowledge of which is fundamental to an understanding of the chemical properties and transformations of the material.

By disintegration of wood with chlorine under the direct rays of sunlight instead of diffused light the soluble part of the cellulose was largely increased and the solid residue diminished. The scientific value of this result lies in the new soluble fractions made available for analysis and study. From the immediately practical point of view, it may point the way to larger yields of pulp from wood by excluding light from vessels in the beating and bleaching operations.

Lignin, a material making up one-third the weight of wood, is at present a mere industrial waste, of practically unknown composition, with few if any uses and an urgent disposal problem. Yet if its chemistry were better understood, it might prove as rich a source of useful products as the once disregarded coal tars. It was discovered that after all possible carbohydrates or sugarlike bodies had been removed from lignin, more of them could still be produced on suitable chemical treatment. If, as seems likely, these carbohydrates were not present in the original wood but were made by chemical action on the lignin itself, an important clue to the composition and properties of the material has been developed. This clue will be followed up in the intensive study of lignin planned for the coming year.

The chemical study of wood extractives was supplemented by an investigation of their influence on the mechanical properties of black locust, western red cedar, and redwood. In each species the heartwood, containing the extractives, was found higher than the sapwood in certain strength properties, the difference in crushing strength, particularly, being considerably greater than differences in weight would indicate. In shock resistance, however, there was some indication of an opposite effect.

Forest Service research in the field of naval-stores production has pointed out important improvements. Preliminary studies of the physiological differences between individual trees as resin yielders were conducted, and preparations for their enlargement are under way. Meanwhile, the facts already known are finding wider practical application. Florida naval-stores factors, in direct touch with practically all turpentine producers in that State and cooperating with leading Georgia factors, this year canceled all old lease forms and issued a new one stipulating that no tree under 9 inches in diameter shall be cupped. Numerous progressive operators took steps to reduce the height of chipping in their workings conformably with Forest Service recommendations. Similar results are following throughout the producing region.

WOODS AND MILL INVESTIGATIONS

Continuation of logging studies in one region after another has resulted in marked interest on the part of lumbermen as to the effect of selective cutting on production costs and returns and on the possibilities of a short cutting cycle. Definite knowledge of the qualities and sizes of logs that yield a profit is in many cases opening the way to improved woods practice and sustained yield operations by forest owners. Preliminary analysis of the work done during the year in the second-growth shortleaf and loblolly type of the southern pine forest region indicated that the manufacture of lumber from trees 10 inches in diameter netted a loss of \$3.29 per thousand board feet, not including stumpage, as against a profit of \$11.73 from 24-inch trees. Figures are being worked out for the three other southern pine types and the other methods of operation studied during the year. A technical bulletin on the selective logging of hardwoods in the Lake States, based on previous studies, was published and widely distributed.

Selective cutting provides a means of natural restocking of the land, makes possible a short cutting cycle, allows selection of the material and of the place of cutting, and maintains or increases the profits to the owner as compared to other forms of forest management.

The field work on a very comprehensive woods and mill study in California was completed. It involved following from the woods through the mill about 1,000 trees, cut into about 5,000 logs, to ascertain the amount of lumber by grades that each tree yielded. A study made in Oregon showed that to produce western yellow-pine lumber from 10-inch trees cost about \$10 per thousand feet more than the value of the lumber, whereas with 30-inch trees the cost was about \$10 less than the value. The results of this study were published serially in a lumber trade journal. Marked progress was made in studies that have been under way in the Inland Empire for several years to determine the amount of waste in logging due to breakage in felling and in gravity chuting. These woods and mill studies are of direct aid in national-forest management as well as in the development of commercial forestry.

Special attention is being given the small mill in order to find means of compensating for or correcting its bad points and so utilizing its good points that it may sooner find its permanent place in sustained forest practice. Investigation thus far shows that the small mill operator, in figuring his production costs, ordinarily ignores items amounting to some \$2.50 per thousand board feet, or from 9 to 22 per cent of the total cost, and that by greater care in the adjustment of set works on the carriage the yield of salable lumber can be increased by as much as \$1.60 per thousand.

The development of log grades, practical seasoning and stain-prevention methods, and simple rules for lumber grading adapted to the requirements of the small operator are other items receiving attention. The plan of work that has been put into effect during the year calls for close cooperation between the Forest Products Laboratory and field agencies of Federal, State, and commercial forestry interests, and the response thus far is most encouraging.

Analysis of the data obtained last year in studies of dimension-stock production from woods and mill waste in the Lake States

showed that with fair-quality logs between 8 and 11 inches in diameter there was a margin of \$13 per thousand board feet between cost of production and selling price at the mills studied. Costs decreased and values increased with increase in the size of logs. The cutting of dimension stock instead of lumber may be one solution of the problem of small and defective logs.

Arrangements are well under way for work in the Northeast on methods of dimension-stock production adapted to small operations or groups of operations as a solution of the marketing problem of small mills. The investigation is expected also to produce methods adapted to the handling of pulpwood species and thinnings.

A great and significant increase has taken place in the last 10 years in the use by the wood-consuming industries of cut-to-size stock instead of standard lumber. This change in industrial point of view, which in a considerable degree has been based on the work of the laboratory, should be applied increasingly to woods and forestry practice through continued research and demonstration.

SELECTION AND PREPARATION OF WOOD FOR USE REQUIREMENTS

The effective and discriminating adaptation of wood to the requirements of specific uses will more and more determine its ability to hold markets under modern conditions of competition; hence there is need for increased knowledge about and care in the selection, seasoning, grading, and handling of the material. This does not mean the narrowing of the utilization field to a few superior species but the intelligent preparation of many species to meet varied demands.

New knowledge of the properties of different kinds and grades of lumber was afforded by the analysis of data on the characteristic effects of 13 leading commercial softwoods. The results, to be published as a technical bulletin, have already proved of distinct value in the study of species for various uses and in dealing with important inquiries, and will assist lumber consumers in selecting material and lumber producers in improving and standardizing grades.

In Michigan, Wisconsin, and Minnesota alone some 29,000,000 acres of logged-off lands have grown up to aspen, a so-called weed species. The laboratory, in cooperation with other Forest Service units, prepared a publication on the properties and uses of aspen, showing its availability for pulpwood, boxing and crating stock, and a wide variety of small manufactures for which its properties are comparable to those of basswood and yellow poplar.

A similar study of western larch, now largely unused or sold in mixture with other species, showed that the species is in reality one of our best general-utility woods and should be readily marketable under its own name if given proper seasoning and attention.

Continuation of dry-kiln studies showed that casehardening of lumber can be reduced still further by modifications of the drying conditions to suit two main types of wood, the sapwood type and the heartwood or refractory type. In the latter type, such as white oak, red gum, and the heartwood of most species, the degree of casehardening was found to be determined by the slope of the moisture gradient between the drying surface and the boundary of the saturated interior of the piece, and compensating humidity, tempera-

ture, and circulation controls were worked out for the improvement of drying schedules.

Previous studies of the seasoning of many species of lumber from the various producing regions of the country have shown that wide variations in the moisture content of the seasoned stock above and below the average are a prevalent feature of both air-drying and kiln-drying practice. Efforts are being made to determine and correct the causes of this variation. In an extended investigation of the kiln drying of Douglas fir nonuniform drying was found to be due principally to inadequate kiln design and not to inherent characteristics of the species. In keeping with the findings of this study, kiln manufacturers have revised their design factors to provide increased circulation efficiency. Drying investigations of other western woods are under way.

Little difference between mild and rather severe seasoning schedules was observed in a study of the drying of small-dimension stock from woods waste of maple and birch in sizes up to 1 by 6 inches and 1½ by 4 by 48 inches. In all cases the chief source of degradation was warping. Since end coating reduced checking to a minimum under the severest kiln conditions used, it is clear that for this class of stock accurate control of temperature and humidity is not particularly important. The amount of warp, measured in depth of bow per foot, was found to decrease considerably as the length and width of the piece increased. The production problem thus centers around sawing methods rather than seasoning. Satisfactory small-dimension stock could be made by cutting up the larger pieces after seasoning.

A bulletin on the kiln-drying of southern pine, intended particularly to reduce the quantity of degraded lumber in select and No. 1 common grades, was published and distributed in the industry. A bulletin on effective commercial air-seasoning methods for lumber was also issued and distributed to lumber manufacturers, dealers, and fabricators.

Theoretical and experimental studies of the kiln-drying of wood led to the completion of a master chart by the use of which drying rates, under any reasonable combination of kiln temperature and relative humidity, can be predicted from characteristics of the wood. These characteristics can be determined by a relatively small number of experimental kiln runs with each species. Since the new method successfully differentiates between the effects of temperature and humidity on drying rates, it constitutes a long step forward in the science of wood seasoning. Briefly, the tests required to establish complete drying curves by this method are numbered in tens instead of the thousands formerly needed.

The shrinking, swelling, and opening of joints of wood in service is due in part to drying the lumber to a moisture content too high or too low for the humidity conditions of the locality in which it is to be used. Complete data on the varying moisture content of wood in dwellings in five typical climatic regions of the United States showed yearly ranges varying from only 0.7 per cent in Portland, Oreg., to 3.8 per cent in Madison, Wis., with the actual moisture content varying from a low of 5.1 per cent in Albuquerque, N. Mex., to a high of 12.8 per cent in New Orleans, La. In northern locations a drop of as much as 2 per cent in the moisture content of woodwork was shown to occur in the fall months when the house-heating plant

as coming into steady use, with a correspondingly sharp increase in the spring. The data are now under analysis to show the influence of types of construction, heating plants, and other factors on the conditions of exterior and interior woodwork, and the results will be published for the information of owners, contractors, millwork manufacturers, and furniture makers who are concerned with the proper seasoning, handling, and use of wood in relation to climatic conditions. A leaflet was published during the year, pointing out the necessity and the means of keeping new flooring and woodwork dry at all stages of house construction, to prevent cracking and opening of joints after the house is occupied.

A needed investigation of the storage and handling of lumber in the yards and on the construction site was initiated, with the cooperation of interests concerned, and preliminary surveys of yards in the West, Middle West, South, and East were made. Bad practice, as a rule, appeared to predominate over good. Leaky roofs of storage sheds, green stock piled at mills and in dealers' yards with insufficient provisions for proper air circulation, low, damp, and rotten foundations, and poor segregation of green and dry material both in shipment and in storage were common. Such conditions, if generally permitted, are bound to nullify much of the gain that has been made in seasoning methods and to react widely against wood as a building material. A comparison of types of open and closed lumber sheds was begun at four yards in Chicago and at two southern pine mills. Assistance in a campaign to improve the storage and handling situation throughout the country is hoped for through closer laboratory contacts with engineers and architects.

An electrically operated instrument for the instantaneous measurement of the moisture content of lumber, embodying operating improvements over available commercial models, was perfected last year. Characteristics of the new instrument, described as a blinker machine, are simplicity, economy of construction and operation, portability, and accuracy to a moisture content of about 1 per cent. Its useful range is from 7 to 24 per cent moisture content.

INTERNAL AND SURFACE TREATMENT OF WOOD

One of the most productive fields in which forest products research has engaged is the modifying of wood properties by various types of treatment to enhance the values of the material, lengthen its life in service, and enable it to hold its place in use against new and competitive materials.

An important aspect of this work is the treatment of ties and timber with creosote and other preservatives. Laboratory studies on the impregnation of Engelmann spruce, followed by field demonstrations at railroad and commercial tie-treating plants, showed that it is possible to secure satisfactory absorption and penetration. Previously Engelmann spruce had been regarded as extremely resistant to treatment, and railroads of the Rocky Mountain region were at the point of refusing to accept any more ties of this wood, which is one of the most plentiful in the national forests in Colorado, Wyoming, and Utah. Such refusal would have been very serious from the standpoint of proper management of these forests.

Studies of the fireproofing of wood were continued. It is possible, although costly, to treat wood so that it will not burn by itself. Less expensive treatments must be found before wood treated to make it fire resistant is within the reach of the average consumer. The firetube method of testing developed at the Forest Products Laboratory is being used in an extensive survey of chemicals to determine which give promise of commercial usefulness as fire retardants. Results of intensive studies of zinc chloride and diammonium phosphates were published.

Progress made last year in securing information about the durability of glued joints under extremely severe moisture conditions promises to react beneficially on the manufacture of aircraft, automobile bodies, and many other specialties. Water-resistant case-hardened glued joints, impregnated with creosote or beta-naphthol after gluing, showed practically full strength after two and one-half years of continuous exposure to nearly saturated atmosphere, whereas untreated joints failed completely in about half the time. One series of treated blood-albumin plywood specimens, exposed for four and one-half years in a moisture-saturated atmosphere, showed no appreciable loss in strength. Adding the preservatives directly to the glues also increased their durability, but the untreated wood decay and failure occurred sooner than when the whole joint was treated.

A bulletin describing and explaining the special phases of wood gluing in aircraft manufacture was prepared.

The study of painting characteristics of softwoods, carried on for five years, has made it possible to classify the principal American softwoods in four groups with respect to painting quality. The lighter, even-textured woods hold paint coatings longer than those of greater density and uneven texture, and spring wood gives better anchorage for paint than summer wood. A leaflet presenting the results and other findings of the investigation in simple and summarized form was published in 1930 and the preparation of a technical bulletin was begun. An advisory committee of prominent representatives of the industries was organized to consult with and assist the laboratory in its further painting research. The work to date has made clear that variation between woods in painting characteristics and the most troublesome defects of paint coatings are due to inadequate adhesion between aged coatings and wood. Research should be directed toward the problem of paint adhesion as soon as possible.

The results of many years' experiments with coatings to retard moisture changes in wood were prepared for publication as a technical bulletin. Aluminum leaf is the most nearly impervious of all the coatings tried, with aluminum powder varnishes, certain bituminous preparations, and spar varnish in multiple coats following in order. Many coatings popularly supposed to "seal up" wood against moisture are shown to be very low in effectiveness. Moisture changes and the dimension changes which accompany them cause most of the common difficulties encountered in the use of wood. The field of investigation in moisture-retardant coatings is very large, and new products are constantly being offered. Testing and original research are being continued.

MECHANICAL ADAPTATION OF WOOD TO CONSTRUCTION AND FABRICATION

Over 60 per cent of the lumber produced in the United States is used in building construction, about one-half going to the farm and one-half into urban residences and industrial buildings. In this highly competitive field lumber is losing ground to other materials, not primarily because of its unfitness but because of inefficient design and use, as evidenced by twisted buildings, bulged sides, sagged roofs, rickled rafters, broken ties and beams, misfit doors, hay carriers out of commission, and farm and other buildings demolished by storms or worn down because unserviceable. Tests of timber, structural combinations, and fabricated parts are conducted by the laboratory to promote the use of wood in strong, efficient, and satisfactory construction. Rules for the design of bolted and fishplated timber joints were worked out last year through tests on joints of Douglas fir, southern pine, spruce, oak, and maple fastened with common steel bolts of diameters up to 1 inch. Steel fishplates, replacing wood cleats, were found to increase the efficiency of joints 25 per cent. As a result of the tests the allowable stress in joints at any angle with the grain of the wood can be calculated from the diameter, length, and number of bolts. Since disastrous failures of wood construction often occur as a result of faulty jointing, the engineering value of this study is obvious. The results, to be published in bulletin form, will replace much rule-of-thumb with new technical facts.

The details studied are essential to proper construction in building as well as other lumber uses, but they are only a beginning. The design of most frame buildings is such that the stresses in the members are indeterminate, and it is only through tests of the wall panel, the entire floor panel, the braced rafter, the roof truss, and ultimately the entire building, that proper design will be obtained.

Five studies of the use of wood in aircraft were published or made ready for publication as technical reports of the National Advisory Committee for Aeronautics. These concern the torsional resistance of wing-beam sections, the design of plywood webs for beams, the design of wing ribs, a method of calculating the ultimate strength of continuous beams, and the properties and selection of aircraft woods. Their publication places at the disposal of civilian aircraft engineers and builders the results of years of research carried through as a special cooperative project for the Army and Navy Air Services. Furthermore, they illustrate the successful adaptation of wood to one of its most exacting uses, a fact which promises well for the future of wood in the general engineering field.

Tests to determine the effect of moisture distribution on the strength of poles and structural timbers were completed. The results show that the effects of moisture in large members under outdoor service conditions are difficult to predict theoretically, and that strength values for members of a given species should be judged by tests of the members similarly exposed, rather than evaluated by rule. Recommendations to this effect, with a record of the tests on which they are based, were published in association proceedings.

Shipping crates for bulky commodities are often so insecurely packed that heavy stresses in transit fall upon the commodity itself, with resultant damage. A recent laboratory analysis of stresses

occurring in crates led to published recommendations that show how to prevent such damages through more effective yet economical use of wood bracing. Facts obtained by the laboratory in its preliminary survey of damage to canned foods in transit were embodied this year in a leaflet issued to freight claim representatives by the American Railway Association, calling for improved stowage and better preparation of cars to receive freight. A comprehensive manual of box and crate construction forming a general summary of the laboratory container investigations up to the present was issued. It met with a demand from shippers and railway men that quickly exhausted the first printing. Other laboratory publications on the mechanics of wood and wood construction during the year included a department bulletin on the strength of timber columns that presented a new formula for column design, and also a bulletin giving simplified comparative figures for the strength of American woods.

WIDENING WOOD-PULP RESOURCES

If research can succeed in bringing about the practical commercial utilization of logging and milling wastes, of little-used species, and of varied types of second-growth timber in the economic production of pulp and paper of the right characteristics, not only will ample wood be available to meet our entire pulp and paper requirements but some of the most troublesome problems of American forestry and land use will be solved. These considerations clearly define the objectives of pulp and paper research at the Forest Products Laboratory.

Favorable results previously reported in the production of strong white papers from southern loblolly pine were practically duplicated this year with longleaf by use of the laboratory's modified sulphite process. Slash and shortleaf will follow next in the southern pine pulping program, and meanwhile close study is being given to the development of products that can be manufactured cheaply and so in large volume. Satisfactory book, writing, and grease-proof papers were produced from longleaf, and a highly transparent glassine, largely of longleaf was made. The importance of the southern pine as a pulp-wood resource is measured by the great geographical rarity of these woods, their rapid growth rate, and their nearness to markets.

Black gum, a southern hardwood species in large supply, yielded an easy-bleaching pulp suitable for book, magazine, and writing papers, when pulped experimentally by the sulphite process. In the evaluation studies mentioned earlier a representative selection of American species was investigated for pulping quality. A thorough study of the pulping of southern cypress from the Everglades produced book and wrapping papers of fair quality, but in now superior to those made from the pines and other readily available woods. However, an eminently satisfactory insulating board was produced. This offers the best commercial possibilities for the material, since the fibers apparently retain characteristics of the original wood which give it distinctive values in construction.

The utilization of flax straw and hemp in pulp and paper production hinges on an efficient process for separating the strong bast fiber from the woody shive. If this is accomplished, the two components may then be processed by the methods best suited to preserve or develop their most valuable properties. The application of certain separation

principles, well known in the mining industry but heretofore not used for separating fibers, has given promising results, but its efficiency as a means of preparing paper-making fiber must still be demonstrated. Seed-flax straw contains from 3 to 3½ per cent of waxy material readily extracted with organic solvents. One constituent of this material, amounting to approximately one-third of the extractive, has been identified as a sterol. In this class of compounds one—namely, ergosterol—is at the present time industrially important. Ergosterol when treated with ultra-violet light becomes antirachitic and is used in the treatment of rickets and similar disorders. The flax-wax sterol constituent has been subjected to ultra-violet light and been found to acquire distinct antirachitic properties. The matter is being given further study.

IMPROVEMENT OF PULPING PROCESSES

"Black liquor" (used cooking chemical) in the proportion of 40 per cent of total cooking solution was successfully reused in the pulping of pine by the modified sulphate process. This is a development of considerable promise in simplifying the problem of recovery of chemicals. Efforts are being made to extend the advantage of sulphite pulping—high yield, strength, and easy bleaching—to woods of high resin content. Very favorable technical results were obtained with jack pine and other resinous species by substituting soda for the usual lime base. Soda is more expensive, but if the improved quality of pulp warrants the operation of a soda recovery cycle a great source of stream pollution would be eliminated. The problem of soda recovery is now being studied with this major objective in view.

Methods for closer control of laboratory processes, means of evaluating products, and refinements of operation were sought in order to obtain more effective and adaptable research results. A method of evaluating pulps by screen analysis, rate of flow, and static bending tests to determine their paper-making characteristics was developed. A new pore-volume apparatus was devised which more accurately determines the actual volume of solids and voids in a sample than any instrument used heretofore. This facilitated the closer evaluation of finished papers and the characterization of different types of paper. A study of the mechanical variables of the paper-making process was begun, in which the "draw" or tension on the sheet between successive machine sections is the first factor to be studied.

RANGE INVESTIGATIONS

Research to develop a scientific basis for range management began in 1910, when general studies throughout the national forests sought early answers to the first problems of grazing administration. During recent years more intensive work has been carried on, largely concentrated in central Utah and on two range reserves in the Southwest. Range lands furnish about 70 per cent of the feed for all livestock in the 11 far Western States, and constitute the major part of the watersheds from which the 19,000,000 acres of irrigated land in these States derive their water. Except on the national forests, where the productivity of the ranges has been improving, deterioration has reduced the vegetative cover on most of the western range, a large part of which is federally owned, by from one-half to

two-thirds in quantity and by even more in economic value. This has not only seriously affected livestock production but also greatly increased soil erosion and intensified flood damage. The object of range research is to develop sound practices of range management and range livestock management, and of regulated range use that will adequately protect timber resources, and in connection with erosion-streamflow investigations to protect water resources, without unnecessary curtailment of grazing.

In brief, the more important results obtained to date are:

The development of systems of range use which maintain the forage resource and increase carrying capacity by applying as basic principles deferred grazing and rotation grazing.

The accumulation of a large body of knowledge regarding the practical possibilities of artificially seeding range lands.

Establishment of the underlying principles that determine whether certain specific types of mountain range may be grazed without injury to the vegetation.

The development of improved methods of managing livestock on the range. For sheep and goats the principal improvements have been through open herding, bedding out, and better lambing and kidding practices, leading to greater production, better growth, and higher market values. For cattle the improved methods have concerned mainly more efficient salting practices and the development of water, resulting in better distribution of the stock on the range with fuller utilization of the forage crop and the prevention of overgrazing of limited areas through unnecessary concentration.

To these may be added the development of practical methods of eradicating tall larkspur, waterhemlock, death camas, and various other poisonous plants.

The McSweeney-McNary Act afforded a basis for planning a broader range-research program, organized along regional lines in place of local studies. In the Intermountain Region an appropriate permitting the establishment of the Intermountain Forest and Range Experiment Station makes possible an attack on the spring-fall and winter-desert range problems, two of the most critical confronting the range livestock industry. The cooperative studies of range-sheep management at the sheep experiment station maintained by the Bureau of Animal Industry in Idaho were materially expanded. They have shown the inadvisability of heavy early spring grazing and the gain in forage and lamb production obtainable through conservative grazing in spring and fall. Plans for similar range-management studies at the range livestock experiment station near Miles City, Mont., are being formulated. For the Southwest funds were provided to study the water requirements of range cattle in the western yellow pine forest type and the forms of livestock management necessary to prevent damage to forest reproduction and at the same time permit the maintenance of a profitable cattle industry. In this type of cattle frequently damage timber reproduction even when considerable forage is on the range. Much of this damage appears to be due to lack of water at watering places or in succulent forage. Similar intensive studies will have to be made on sheep ranges.

An analysis of the results of the investigations that have been underway for 15 years at the Jornada Experimental Range in southern New Mexico made clearer the importance of conservative grazing at a

mes, and of the use of certain specific measures to assure sustained livestock production during extended drought periods. Black grama, the most important range-forage plant on the reserve, suffers severely from too close and too frequent summer utilization and should therefore, if possible, be reserved largely for winter grazing. On the other hand, close and frequent clipping of tobosa grass, which occurs in flooded areas, stimulates its spread by rootstocks and increases forage production, making its full use during summer desirable. A preliminary report of the natural successional development of the plant cover on the sand-hill type was published. A similar report on plant succession on clay soil types of the Jornada is in course of preparation. These studies, as well as those on the better grass types, have demonstrated the necessity of intensive study of the restoration of the badly depleted sand dune and gravelly ridge areas of the Southwest. Such excessively denuded areas are not producing one-tenth of the forage that they might, and this depleted condition now seriously interferes with satisfactory utilization of the better range areas.

Marked progress was made in the analysis of information on the grazing values and growth requirements of western range plants. These studies are defining the plants which are of special significance in scientific range management and research and are determining their general relationships. Several papers were issued dealing with range plants, and a glossary of botanical terms was prepared to aid administrative officers. Knowledge of the western range flora was considerably increased by this year's collections of over 5,000 specimens, particularly with regard to economic values, range extensions, and species new to science or that were little known. Standardization of the nomenclature of western range plants, both English and Latin, was given special attention in cooperation with the Bureau of Plant Industry.

An irreparable loss was suffered in the death, in line of duty, in a forest fire on the Chelan National Forest in August, 1929, of Douglas C. Ingram, a highly capable forest officer, an authority on range management, and an outstanding student, collector, and photographer of the western range flora. In his honor a very handsome native, wild pink, discovered by him, has been named *Silene ingrami*. Effort is being made to grow the species from seed at the Arlington Experiment Farm, Rosslyn, Va., with the hope that eventually it may be introduced into cultivation.

Cooperation between the Forest Service and the extension services of the Department of Agriculture and the various Western States brought about considerable progress in the further development of the extension program of range management. Field days for the demonstration of the practical results of range investigations were held at the Great Basin station and the Jornada and Santa Rita experimental ranges. Stockmen are keenly alive to the value of the results and are pressing the service for further development of research in other parts of the West. Its expansion in the Southwest and inauguration in California are doubtless of most importance, where the interrelationship of grazing to timber production and watershed protection especially demands the study of ways to restore depleted ranges and assure sustained profitable production of livestock without injury to other resources.

EXPENDITURES AND RECEIPTS

The expenditures for all purposes during the fiscal year were follows:

General administration.....		\$392, 640.
Forestry extension.....		180, 521.
Research:		
Silvical investigations.....	\$580, 884. 80	
Forest products investigations.....	640, 299. 19	
Range investigations.....	106, 957. 65	
Taxation study.....	61, 002. 03	
Total.....		1, 389, 143.
Administration, protection, improvement, re- forestation, and extension of the national forests:		
Administration—		
Timber use.....	\$1, 233, 649. 44	
Grazing use.....	959, 196. 21	
Fish and game protection.....	132, 444. 63	
Recreation and land use.....	218, 362. 70	
Examination and adminis- tration of power sites for Federal Power Commis- sion.....	23, 281. 00	
Classification, settlement, and claims.....	61, 235. 87	
General surveys and maps.....	146, 472. 12	
Grazing reconnaissance.....	107, 653. 99	
Timber surveys.....	239, 484. 69	
Subtotal.....		3, 121, 780. 65
Protection—		
Fire prevention and detec- tion.....	2, 166, 422. 36	
Fire suppression.....	3, 754, 469. 08	
Protection against insects and tree diseases.....	320, 568. 28	
Subtotal.....		6, 241, 459. 72
Improvement—		
Construction of improve- ments other than roads, trails, and camp-ground improvements.....	932, 680. 28	
Maintenance of improve- ments other than roads, trails, and camp-ground improvements.....	715, 641. 16	
Camp-ground improve- ments.....	52, 050. 00	
Construction and mainte- nance of roads and trails—		
10 per cent fund under act of Mar. 4, 1913.....	503, 094. 78	
Cooperative construction of roads and trails un- der act of July 11, 1916.....	51, 140. 72	
Forest development roads and trails under act of Nov. 9, 1921.....	3, 135, 980. 44	
Forest highways under act of Nov. 9, 1921.....	4, 778, 610. 46	

Administration, protection, improvement, reforestation, and extension of the national forest:—Continued.

Improvement—Continued.

Road and trail construction from moneys contributed by cooperating agencies under act of June 30, 1914.....	\$1, 275, 056. 15
Contributed from other appropriations.....	186, 847. 22
Class total (roads) ..	9, 930, 541. 97
Subtotal.....	\$11, 631, 101. 21
Reforestation—nurseries and tree planting.....	272, 500. 89
Extension—	
Land exchanges.....	142, 591. 21
Acquisition under act of Mar. 1, 1911, as amended..	2, 025, 839. 27
Subtotal.....	2, 440, 931. 37
Total.....	\$23, 435, 272. 95
Protection and reforestation of other than national forest lands—	
Tree planting in cooperation with States under act of June 7, 1924.....	81, 035. 69
Fire protection in cooperation with States under act of June 7, 1924.....	1, 330, 875. 96
Protection of Oregon & California grant lands.....	93, 847. 40
Total.....	1, 505, 759. 05
Grand total.....	26, 903, 337. 50

In addition to the expenditure for land extension itemized above the entries "land exchanges" and "acquisition under act of March 1911," national-forest timber having an estimated value of \$454,117 is cut under agreements involving the acquisition of land and timber through exchanges. The cash disbursements recorded under "land exchanges" cover merely the outlay incidental to examining lands offered for exchange and appraising the values involved.

The cash receipts from the national forests were as follows:

from the use of timber.....	\$4, 389, 893. 00
from the use of forage.....	1, 942, 914. 19
from miscellaneous uses, including the use of land, water-power fees, etc.....	418, 746. 03
Total.....	6, 751, 553. 22

The total is greater by \$451,751.36 than that for the previous year. Receipts from timber increased \$281,298. Grazing receipts were greater by \$202,624.38 and miscellaneous receipts decreased by \$171.02.

In addition to the cash receipts from timber there should be credited the value of the timber cut under specific agreements for effecting land exchanges, estimated at \$454,117.

REPORT OF THE FORESTER

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., September 1, 1931.

SIR: I transmit herewith the report of the Forest Service for the calendar year ended June 30, 1931.

Respectfully,

ROBERT Y. STUART, *Forester.*

HON. ARTHUR M. HYDE,
Secretary of Agriculture.

FORESTRY AND AGRICULTURE

The serious consequences that lack of economic balances and stability may produce have been deeply impressed upon the public mind during the past two years. Lack of balance and lack of stability conspicuously characterize the relationships between forest use in the United States and the forest resource. The causes are deep-seated, and the resulting maladjustment is chronic, not temporary. In this respect it bears a close resemblance to the maladjustments that affect agriculture. Indeed, the forest problem and the agricultural problem are in many ways interrelated. Both call for foresighted planning and wisely directed public and private effort to adjust production to needs, and to bring about the utilization of our vast land resources along the lines that will contribute most to our permanent national welfare.

This is a long-time matter. A reasonably stabilized adjustment in form and manner of use to the most basic of all resources, the soil, with its enormously varying characteristics and possibilities, can be made only through a gradual advance. The advance is bound to be made, in one way or another. It may be made blindly, under a "hands-off" policy that leaves everything to economic evolution and the struggle of each man to get out of his difficulties and improve his lot as best he may. The Nation, however, is committed to a different course. It has gone far in the development of public policies and the adoption of public measures to promote efficient land use and to facilitate economic progress along lines that will make the processes of adjustment less wasteful, and more beneficial in terms of social welfare. The question is not whether foresighted planning shall be entered upon. It has been entered upon. The question is of the degree of intelligence with which it is to be carried out.

The public policies that have in view the bringing about of a more successful adjustment of the national economic life to the greatest

of natural resources, the soil, are the policies that relate to agriculture, forestry, and the public lands. Public-land policies bring in also other questions of utilization. The utilization of the mineral resources of the public lands raises questions of policy that are in the main independent of those concerning soil use. Water and soil resources, on the other hand, are so closely interrelated that they cannot be dealt with independently. Long-time planning must take account of both as requiring common measures. From a long-time standpoint, public policies with respect to agriculture, forestry, and public-lands utilization, other than mining utilization, have a common goal—efficient soil use.

The land area of the United States is capable of producing agricultural products materially in excess of the present consumptive needs of the country. More land has been brought under cultivation than can be farmed, if the farming is well done, without creating burdensome agricultural surpluses. This has brought to the fore the unwisdom of enlarging further the area of cultivated land through the clearing of forest lands that have low value for agriculture. It has raised the question of restoring to use for forest production millions of acres of marginal and submarginal farmlands. Only within the last decade has public thought turned toward the idea that farming might be overdone—that its development did not imply the expansion of agriculture at the expense of the forests. Now the desire in a good many States runs the other way. Public policies are taking shape that seek to reclothe with forests borderlands on which agriculture can no longer be practiced successfully and cut-over lands formerly thought to be destined for agricultural use. It is becoming widely recognized that the best interests of agriculture in the long run, will be best served by bringing about the use of land for whatever purpose it is best fitted for, that a great deal of land has been mistakenly cleared, and that it is a matter of large public importance to bring about the growing of forest crops as a means of utilizing lands that agriculture will not employ.

Slackening increase in population and present trends in agriculture make it clear that intensive use of our entire land area will not be necessary for a long time to come. This places us in the fortunate position of being able to locate our agriculture where production can be carried on most effectively. In the same way intensive forest production should be allocated to those portions of the remaining area where production is most effective and most needed. The residue, under proper ownership and control, can serve the needs of the Nation for water conservation, for grazing, for recreation, and in other ways, under such restrictions as will safeguard until it is required for more intensive use. It would be wrong to assume that all forest lands can profitably be used for intensive forest culture, just as the former assumption that all tillable land could be used for agriculture has proved to be wrong.

THE PROBLEMS OF THE LUMBER INDUSTRY

Large profits from lumber operations and from increases in stumpage values in the Lake States, and to a less degree in the southern pine region, led at the end of the last century and early in the present to the acquisition by lumbermen of large timber holdings in

cific Northwest. These timberlands were derived from the public main through the railroad and other land grants and under the hber and stone, homestead, and other general public land laws. rapid increase in the consumption and prices of lumber in this coun- y up to about 1907 led to the belief that this timber investment uld, in a relatively few years, be liquidated at a large profit. ving chiefly to a decrease in the rate of lumber consumption and to e unexpected continued productivity of the southern forests, this pectation has not been realized. Forest industry thus finds itself, th in the southern-pine region and in the Pacific Northwest, in ssession of forest resources better adapted to permanent produc- n than to the early liquidation upon which its plans were based. is requires a gradual readjustment of the financial basis of the ustries, as well as of manufacturing and sales policies, to a long- ne program. The process of adjustment necessarily creates condi- ns of temporary industrial instability, for which the only adequate d final cure is production based on sound land use.

In the last quarter-century our per capita consumption of lumber s been cut almost in half—without taking into account the great rther decrease that has occurred in consequence of the present gen- al business inactivity. The growth of the country in population, wever, has partly offset this decrease. Lumber consumption prior 1930 fell off only about 25 per cent from the peak year of 1906. a the other hand, pulp and paper consumption has increased. The rsatility of and rapid change in modern industry now make it possible to predict too far ahead the demand for any product. large part of the decline in lumber consumption is attributable to ere curtailment of farm buying power. Whether the demand will rease in the eastern United States as local forests are restored productivity can not now be foretold. Competing products have aded the field, partly because of the efficient merchandizing meth- s employed in their sale and partly because of their superiority for rious specific purposes. Many of the lumber substitutes are them- ves made from wood fiber. Frequently these products contribute the efficiency of wood use. The necessity of the forest industry lexibility in production of any one product and the utmost divers- ion and variety in the products marketed. An effective mer- andizing policy must also be an integral part of future plans. Lumber and many of the other commodities produced from wood e of low value in comparison with their weight. This means that nsportation plays a large part in the cost to the consumer, and t whenever a long freight haul intervenes, the cost to the con- ner is relatively high and the producer's share of the price paid atively small. The persistence of lumber consumption at a time en a large percentage of the supply is hauled over 2,000 miles a remarkable economic fact. It suggests that with lower-cost uction reestablished in eastern regions, wood will remain a ular commodity.

The forest-using industries provide the market for wood. Forest oilization is tied in with their stabilization. Chief among them, of rse, is the lumber industry. It has always been essentially unstable, he sense that as an exploitative industry it has been shifting. Its ndividual establishments have been temporary, moving from one

location to another as new stumpage supplies became necessary while the industry as a whole has been moving its center successively from one great forest region to another as regional depletion of virgin timber stands dictated. It can shift no farther; its development in the great forests of the Pacific coast leaves it no new region to exploit in the United States.

Now the lumber industry is unstable for another reason. Its effort to liquidate its Pacific coast holdings at the favorable stumpage prices which had been built up, its sawmill capacity has been overdeveloped. The effort to market the output from this large production capacity has disorganized the lumber markets of the country. This has created the dual problem of reducing sawmill capacity and simultaneously revising timber-holding policies from a liquidating to a sustained-yield basis—liquidation having proved impossible.

While industrial disorganization, market demoralization, and business instability are widespread throughout the industry, the Pacific Northwest is the main seat of the disorder. Its cause is the attempt to liquidate in a short period a resource which is undoubtedly capable of producing forever an annual output equal to the normal production of such years as 1926 to 1929. The wastage in this liquidation policy, both from the standpoint of the depletion charges involved and from the standpoint of current overproduction for the market, is proving too great a strain on the financial resources of the industry. It becomes necessary, therefore, for the industry as well as the general public to recognize that it is dealing primarily with a continuously productive resource rather than a mere store of raw material. How far-reaching the changes in capitalization, organization, and other functions of the industry will be, can not be foretold. While there is no doubt that an excess of capital has been invested in sawmills, only time can tell whether the privately owned forest resource has been overcapitalized.

To obtain consideration of public measures that may afford relief, which the lumber industry can not bring about without some form of public aid, its representatives, joined by representatives of other forest industries and of conservation organizations, appealed to the President of the United States in the spring of 1930 to create a commission of inquiry. The President some months later appointed a Timber Conservation Board, with a membership made up of cabinet officers, representatives of the lumber and other forest industries, and representatives of the general public. An advisory committee was created under this board, to assist in making an exhaustive study of the whole situation. Through representation on this committee the Forest Service is directly brought into the work.

One of the questions raised is that of the competition of national forest stumpage, through timber sales to operators wishing to manufacture the Government timber, with private stumpage seeking the market. The cut from the national forests constitutes a very small fraction of the total lumber cut, and the policy of the Forest Service has for some years steadily aimed at avoiding the development of new large-scale national-forest operations that would tend to demoralize farther the western lumber markets. On the initiative of the President and at his express direction, this policy has been temporarily extended and made more drastic, as is set forth

greater detail further on in this report. The whole question of the policy governing the sales made on national-forest and other federally owned land is being made a subject of special inquiry by the Timber Conservation Board.

THE PROBLEM OF WESTERN FOREST OWNERSHIP

While the objective of the lumber industry is to obtain its own stabilization as an escape from the disorganized and demoralized external conditions due to the present overload of stumpage, its leaders for the most part recognize that permanent stabilization lies beyond that. It involves a full transition from dependence on forests as a gift of nature to dependence upon forest crops. When that takes place land-use stabilization will have taken place. The national-forest policy has brought the greater part of the western forest-land area, but not of the western timber now marketable, under stabilized ownership. The national parks add their quota to stabilization through Federal administration for public purposes. Land acquisition under the exchange policy will, to a minor degree, add to the western national-forest area. Western private forest policies are to some extent shifting toward retention and permanent administration of at least a part of their approximately 100,000,000 acres of forest land. Most of the nearly 7,000,000 acres of Federal forest land included in Indian reservations and all of several million acres more of forest land still left in the open public domain have no definite policy formulated by laws of Congress which assure their stability. The crux of the western problem of permanent stabilization, however, concerns the future of 57,000,000 acres of private forest lands, now principally held by lumber companies and other timberland owners, not with a view to permanent ownership, but as an incident to disposal, by sale or manufacture, of the removable-timber values.

The conclusion seems inescapable that much of this land will eventually revert to the States or to counties. Cut-over lands are already becoming tax delinquent on an alarming scale, in several States. Timber is one of the principal sources of western tax revenues. As the timber is cut off the value of the land is greatly lowered. A good deal of the uncut timber can not be converted into lumber with recovery of the cost involved, at the level of lumber prices that prevailed during the five years prior to the 1929 slump. There is no reason to anticipate a rise in lumber prices that will ever enable the private owners to recover their carrying charges from the time of cutting, on the lands of lowest value. From this source as well as through the abandonment of cut-over lands, a compulsory enlargement of public ownership is probable.

Western State policies of forestry have not yet reached a secure basis. The protection of western State and private-forest lands against fire depends for support principally on the interest and the expenditures or contributions of the landowners, supplemented by Federal cooperative funds. The States pay little more than their proportionate share as landowners, plus some overhead. As the private stands are logged the interest of the owners tends to disappear. If they drop out, their share of the cost of maintaining the

protective system is added to their tax bills—which increases the centive to abandon title to cut-over lands. After the land pa to the State or to the counties, the burden becomes theirs. It very serious question whether the shifting of this burden thro land abandonment will not impose a public cost which, in the of dwindling tax receipts from private timber, the local public not know how to meet. There is also much uncertainty as to far the Western States will go in extending stabilized public ow ship to forest areas not embraced in the national-forest system.

Under their various land grants the Western States received stantial portions of the public domain timberlands within t borders. In part these were quantity grants, but the bulk of lands were in scattered sections. Diverse land policies have k pursued, and a number of the States have relatively little of t forest lands left. On the other hand Washington has nea 1,400,000 acres, Idaho nearly 1,000,000, and Montana about 500,

It is of course impracticable to administer as permanent fo properties, small, widely scattered parcels of land. To block up national forests and to give the States the advantage of solid holdi in place of isolated sections, land exchanges have been arranged v a number of the Western States. This process of consolidation by no means complete, partly because of lack of inclination on part of some of the States to obtain consolidated holdings, pa because of prohibitory constitutional provisions in certain ca partly because plans for contemplated exchanges have not yet k carried through to final accomplishment. The largest acreages national-forest lands in solid blocks suitable for permanent admi tration as State forests have been obtained by Washington, with n than 400,000 acres; Idaho, with nearly 300,000 acres; and Mont with more than 100,000 acres. Certain other substantially blocked holdings place these three States in possession of some additio forest areas sufficiently consolidated to afford practical administra units.

Montana has gone beyond any other Western State in prescrib by law for the permanent retention of its forest lands and for establishment of specific State forest units. The legislature created seven such units, with an aggregate area of more than 200 acres, and has ordained that all lands of the State principally valu for the timber on them, or for timber growing, or for waters protection, shall be "forever reserved." New Mexico also at one t prohibited the sale of any State forest land, but subsequently repe the act. Washington has empowered the State forest board to aside specific units as State forests, and also to designate as "S forest lands" and thereby reserve from sale, any lands of the S chiefly valuable for timber growing. No specific administra units have as yet been created in Washington, but more than 1,000 acres have been set apart through designation. Both in Washing and in Montana sales of timber from the reserved lands must under stipulations designed to insure forest perpetuation. So Dakota and New Mexico have laws prescribing this for their tim lands generally.

Idaho imposes similar stipulations in selling timber from blocked-up forest lands, but this is by choice of the State's adm

ative officers, not by any requirement of State law. Idaho has, however, enacted no legislation looking to permanent retention of any of its forest lands. South Dakota has set aside as a State park 1,000 acres, mainly obtained through a national-forest exchange, and several other States have parks of smaller extent. In all, the so-called public land Western States and South Dakota have 66,000 acres in State parks and less than 300,000 acres in organized State forest units set up by or established with the affirmative sanction of State laws. The same 12 States own, as has been already stated, about 3,700,000 acres of forest land. The national-forest area of them is nearly 133,000,000 acres.

That the Western States have progressed slowly in the formulation of policies of public-forest ownership and administration is not to be wondered at. All their granted lands were conveyed to them for specific purposes—common schools, institutions of higher education, penal and charitable institutions, public buildings, and the like. In accepting the lands the States became trustees to carry out the various purposes of the grants. To insure that the State lands should not be disposed of at too low prices, in some cases constitutional provision of a minimum sale price per acre was made. This has blocked the sale of a good deal of land, but it has not altered the obligation of the States to obtain as large returns as possible for the specific purposes contemplated by the grants. To undertake the practice of public forestry as a means of obtaining income from the lands involves a doubtful long-term commitment from the standpoint of a trustee, where the alternative of a sale of the standing timber on favorable terms is open. Considering all the difficulties and uncertainties involved in substituting forest management for forest disposal, State policies that will constitute a reasonable assurance of stabilized ownership for large amounts of salable timberlands obtained through the Federal land grants and still in the possession of the States will have to evolve gradually.

Similarly, policies of extensive State acquisition and retention of private forest lands that the owners do not wish to hold for growing future crops of timber can not be looked for as a sudden development. Local communities dependent upon the public income derived from the taxation of these lands naturally want the lands kept in private ownership if this can possibly be done. The whole theory of the past with respect to tax-reverted lands has been that they should and should go back into private ownership. For the State to take abandoned cut-over lands and timberlands that no private owner is willing to continue to hold, block these lands up into practicable administrative units, protect them against fire, meet the higher costs of administration and reforestation, and provide some equivalent to the local communities for their loss of the taxes formerly paid, will mean the assumption of very heavy burdens. In short, the problem of forest-land stabilization in the Western States is much greater than the States are prepared to cope with unaided. The problem would be enormously greater had not the Federal national forest policy provided a stable form of ownership for the bulk of the forest land in the West. This is generally recognized. While the maintenance and in some cases the extension of the national forest system has hearty approval practically throughout the

West, from time to time proposals are brought forward that constitute a threat to the integrity of the system under the guise of advocacy of a Federal land donation from the national forests, for benefit of some special local public need or State interest. Several such proposals have been recently advanced, and have had strong backing. If the precedent should become established of grants to the Western States of portions of the national forests for one another special local need, movements to obtain similar grants will be looked for in fast-increasing numbers until the whole system becomes riddled and finally disintegrates, with incalculable injury to the West and the Nation.

PROVIDING WORK FOR THE UNEMPLOYED

During the winter of 1929-30 local needs for the employment men out of work were brought forcibly home to field officers of the Forest Service, who were in touch with the situation in their immediate neighborhoods, and some relief was afforded by hastening forward construction programs already financed. In the fall of 1930 plans were again made by forest supervisors and others to carry on construction projects during the winter months. It was realized that this would exhaust the available funds before the close of the fiscal year. Ordinarily the bulk of the construction work is done in the late spring and the summer, when conditions are most favorable. In many communities, however, unemployment conditions were so critical that to provide relief during the winter was held the primary consideration.

The opportunities for providing employment were greatly increased when the act of December 20, 1930, appropriated \$3,000,000 for the construction of roads and trails for national forest protection and utilization. The money was made available to the Forest Service on December 29, 1930. The act of February 6, 1931, added \$354,800 for insect-control work and administrative and range improvements on the national forests. In addition portions of the regular 1932 Forest Service appropriations were made immediately available on passage of the agricultural appropriation act on February 23, 1931. The amounts were: \$45,000 for the control of white pine blister rust, \$40,000 for the construction and maintenance improvements on public camp grounds, and \$494,200 for the construction of protective improvements.

As soon as it became apparent, in December, 1930, that an emergency construction appropriation probably would be available, preparation was made to expedite the work which would thus be financed. During the winter and early spring months the weather and the snow on the ground preclude efficient construction on many portions of the national forests, but so much work is needed that many planned projects can be selected which may be prosecuted with fair efficiency even in the dead of winter. The need for employment in numerous localities adjacent to the national forests was the more acute because of the drought of the preceding summer and the very sharp curtailment in employment during the preceding season in the lumbering and mining industries, while the onset of winter weather increased the suffering. Bids for furnishing a part

of the equipment that would be required to carry on the work were circulated before the emergency construction act was passed, wards were made within a few days after the appropriation was made available, and in some cases equipment was on the ground within 10 days. Final touches were given to the plans for the expenditure of the \$3,000,000 fund; and in January work was actually started in practically every State in which national forests are located, and on many projects.

By the end of January, 3,083 men had been given employment from the emergency construction appropriation. Preference was usually given to men with families, and to spread the relief more widely alternating crews were often employed. Local forest officers worked in cooperation with the Red Cross and similar organizations. In some cases the Red Cross selected the men. In February, 4,311 were given employment, and in March, 5,449—not all of them continuously, of course. April employments from this appropriation dropped to 4,754, and those in May to 4,558.

Prompt utilization of the unemployment relief appropriation was made possible by two facts. Plans were in existence calling for a large amount of construction work over a wide range of territory, and the Forest Service's decentralized form of organization provided instantly available local leadership and the necessary machinery for starting and conducting the work. Funds were allotted by telegraph to regional foresters, and similarly from them to forest supervisors. Competent executives entirely familiar with local conditions and needs were on the ground and ready with carefully matured plans for a large variety of construction projects known to be required for efficient protection and management of the national forests.

The special appropriations for unemployment relief did not inaugurate new classes of construction work, but supplemented the regular appropriations for prosecuting construction programs already under way. Consequently the funds from the two sources were intermingled, from the standpoint of activities provided for. Table 1 shows the number of employees other than those on record with the Civil Service Commission, employed for varying periods between January 1, 1931, and the close of the fiscal year, from the various appropriations:

TABLE 1.—*Number of temporary employees, by months, January–June, 1931, and appropriations from which they were paid*

Appropriation	Number of men employed in—					
	January	February	March	April	May	June
Salaries and expenses, Forest Service, 1931: Emergency construction.....	3,083	4,311	5,449	4,754	4,558	2,731
Highways within national forests, 1931: Emergency construction.....		192	185	103	269	135
Forest Service, insect infestations: Emergency construction.....		41	122	369	872	731
Salaries and expenses, Forest Service, 1931-32: Improvement.....		1	74	100	502	686
Sanitation and fire prevention.....				10	59	61
Other Forest Service appropriations.....	2,133	2,682	2,921	7,542	12,078	17,314
Total.....	5,216	7,227	8,751	12,878	18,338	21,658

The large increase after March from "all other Forest Service appropriations" was due principally to the employment of fighters in the Eastern and Lake States and in the Pacific Northwest, where an extraordinarily acute fire danger prevailed during April, May, and the first half of June. Employments in May and June also reflected the normal opening up of seasonal activities.

Because of the thousands of individual construction projects involved, their diversified nature, and the intermingling of emergency construction with that paid for from regular appropriations, it is not practicable to make an itemized statement showing separately the projects commenced or completed from emergency funds. Since it was the desire of Congress that the \$3,000,000 appropriated by the act of December 20, 1930, should be expended on roads and trails, by far the greater part of the expenditures for unemployment relief went into this form of construction. Other types of permanent improvements the construction of which was speeded include: Telephone lines needed for fire control in localities where commercial systems are not available; permanent firebreaks placed in strategic locations to facilitate holding fires that escape from initial efforts to control them; many-windowed lookout cabins placed on mountain peaks to house men and instruments properly located to discover lightning and other fires and transmit the alarm; lookout towers where the topography does not provide a natural elevation sharp enough to command the necessary view; dwelling barns, and other structures necessary to provide quarters for men and animals who must be stationed remote from any settlement or rentable quarters; simple office structures for housing records and transacting public business where necessary for district range fences for pastures required in administrative or fire-control work; fences to prevent the trespass of unpermitted stock or to control the drift of permitted stock in order to secure the best utilization of national-forest ranges; water improvements in the form of developing springs and wells, pipe lines, and other works required at ranges and other stations, or for watering livestock on the forest ranges, for public camp grounds; and other camp-ground improvements designed to protect the forests, maintain sanitary conditions, and facilitate public recreational enjoyment of the forests by providing simple structures, clearing away undergrowth and inflammable material, and the like.

Two building projects of exceptional size may be mentioned providing further for employment. The act of April 15, 1931, authorized a new building to house the Forest Products Laboratory at Madison, Wis. The agricultural appropriation act for 1931 made an initial appropriation of \$100,000, and an additional \$800,000 was provided in the 1932 act. Construction work has begun since the close of the fiscal year. By the act of March 4, 1931, \$800,000 was appropriated for the construction of buildings on Government Island at Alameda, Calif., to be located on ground donated by the city of Alameda and to be occupied by the Bureau of Public Roads, the United States Coast Guard, and the Forest Service. Difficulties incident to completion of transfer of title will prevent the beginning of actual construction before October. The buildings to be occupied by the Forest Service will serve as a central supply depot, in place of that now maintained at Ogden, Utah, and as a regional warehouse.

Reference has already been made to the fact that diminished activity in the lumber industry was one of the reasons for the severe unemployment conditions with which local forest officers had to grapple. How heavily national-forest timber sales were curtailed is shown later in this report. There is, however, something to be said on the other side. To some extent the timber resource served as a means of alleviating unemployment.

The whole nature of the national-forest enterprise makes unemployment a matter of direct concern to forest officers. The national forests are not handled primarily as business enterprises to make money, nor as conservation undertakings designed to sacrifice present welfare and present use for the benefit of coming generations. The basic purpose is to develop the potential capacity of the resources to meet human needs, and to expand use up to that capacity, always provided that the resource itself is not dissipated. A sustained yield is sought; and thus the object of management is fundamentally to promote and stabilize prosperity. In short, the national forests are of the nature of public utilities; and since the bulk of their usefulness is to individuals and communities located near them, their local managers, to function intelligently, must always have in view the service of local welfare and must study how to increase the local value of the forests as means of livelihood to those dependent upon them and as contributors to community prosperousness.

One of the principal local values of the forests is their community value as a source of opportunities for employment—sometimes directly by the Government, sometimes by private capital engaged in utilizing a forest resource, sometimes by business enterprises indirectly supported through forest use, and sometimes as an emergency resort that can be made in one way or another a temporary source of income for those out of work. It would be impossible to recount the ways in which the national forests have contributed locally to alleviate the consequences of unemployment. An example or two, however, will serve to bring out the point.

Near Asheville, N. C., certain cuttings were contemplated on a small experimental tract within the Pisgah National Forest. Under arrangements with the associated charities of Asheville, where distress from unemployment was very acute last winter, men selected on the basis of their need for employment cut the material into cordwood. The cordwood was sold by a community wood yard in Asheville, for \$5 a cord, the proceeds going to relief work; the men were paid by a week's rations for three days' work; and the work was distributed among a considerable number of men.

In Arkansas, a forest supervisor, recognizing that dire distress was bound to follow the 1930 drought, began in the fall to offer local farmers with dependent families small sales of oak stumpage at low prices, enabling them to earn enough by cutting and selling live bolts to subsist through the winter. Some 200 families were aided in this way. Since the quantity of suitable stumpage is small, the sale was stopped when spring came, to husband it for future seasons. On the same forest an opportunity to do some cutting to improve the silvicultural condition of the forest was used to give employment to needy local men with dependent families, at an expenditure of some \$12,000 in the course of five months. On a considerable number of forests throughout the East—indeed, wher-

ever available markets and suitable timber made the course feasible. Small sales of stumpage for the production of ties, poles, acid wood, and the like were offered to local citizens who were drought sufferers or jobless, at very moderate prices, to enable them to obtain some return from working in the woods.

Unfortunately, the general business depression so reduced the market for most classes of material that relatively little could be disposed of. Nevertheless, in the aggregate the voluntary, unorganized, matter-of-course efforts of forest officers to utilize all possible opportunities to make their forests and forest activities count as agencies for ameliorating local unemployment difficulties, substantially supplemented what was done in an organized way, through the appropriations as already described.

COST ACCOUNTING

Throughout the business world cost accounting is recognized as an indispensable tool in effective control and coordination of effort. The modern business manager, directing the policy and operation of a large enterprise, must have records that make it possible to visualize the work and progress of the business in order that he may exercise intelligent control over its activities. The Forest Service has for a number of years recognized the need for a more adequate cost accounting system. The increasing complexities and widened scope of its activities had reached a point where its former system was outgrown. A better system, based on modern practice and sound accounting principles, was required to make possible a more economical use of funds and to enable management to balance accomplishment and results with costs.

The development of such a system was made a service project in 1927. It was inaugurated by means of a service-wide cost-accounting discussion course during the winter of 1927-28. The results, conclusions and recommendations were submitted to the Forester, and in June, 1928, a committee on cost accounting met in Denver to formulate a tentative set of principles to be incorporated in the new system. The committee also outlined the mechanics of the proposed system and its application to Forest Service work.

The committee report was then submitted to all field executive officers for comment and suggestions, which were subsequently analyzed in Washington, after which, in the winter of 1928-29, the system was revised. On July 1, 1929, it was installed on 14 selected forests for purposes of experiment, development, and perfection. Its experimental use continued on the so-called "test" forests during 1930. On the basis of reports from these forests and from regional units, submitting criticisms and recommendations, the instructions and forms were again revised and submitted to a special committee for review in the winter of 1930-31. The final draft was printed and distributed to the field in the spring of 1931, and was adopted service-wide July 1, 1931.

The installation of the system is being accomplished in two stages. Only the expenditure-record section is as yet in effect, and the cost-and-investment section will not go into effect until July 1, 1933, to allow time to absorb the work of the first section and set up the new

ry investment records for the second without increasing the clerical personnel.

The new system provides for the separation of expenditures and costs of revenue-producing activities from those pertaining to non-revenue activities. It also provides for the separation of expenditures of an investment nature from those of a purely expense nature and recognizes depreciation as a cost. It is designed with sufficient flexibility to meet not only current but future needs of the service and has every indication of becoming a valuable and practical administrative tool.

LEGISLATION OF THE YEAR

Most of the legislation relating specifically to the work of the Forest Service that was passed during the fiscal year—that is to say, enacted at the third session of the Seventy-first Congress—is mentioned later, in connection with the various activities affected. To facilitate an understanding of the scope and effect of this legislation in its entirety, and to provide a convenient record for consultation in later years, all the acts are listed below.

The acts making or authorizing appropriations were:

The act of December 20, 1930, 46 Stat. 1030, making supplemental appropriations to provide for emergency construction on certain public works during the remainder of the fiscal year, with a view to relieving unemployment.

The first deficiency act, fiscal year 1931, 46 Stat. 1064, approved February 1931.

The second deficiency act, fiscal year 1931, Public, No. 869, approved March 1931.

The agricultural appropriation act, fiscal year 1932, 46 Stat. 1242, approved February 23, 1931.

Mention should also be made of the so-called Brookhart law, act of July 3, 1930, 46 Stat. 1003, authorizing and directing the heads of the executive departments and independent establishments to justify the compensation of certain civilian positions in the field service and prescribing certain increases in rates of salary for the classified civil service.

The acts making or authorizing changes in the area of the national forests were:

The act of July 1, 1930, 46 Stat. 841, adding an area of approximately 1,113 acres to the Boise National Forest.

The act of January 26, 1931, 46 Stat. 1040, adding an area of approximately 289 acres in the State of Wyoming to the Ashley National Forest.

The act of March 4, 1931, 46 Stat. 1521, adding approximately 2,991 acres to the Washakie National Forest in Wyoming.

The act of January 31, 1931, 46 Stat. 1047, transferring 34,000 acres from the Inlier National Forest to Mount Rainier National Park.

The Interior Department appropriation act of February 14, 1931, 46 Stat. 4, which included an item authorizing the President by proclamation to transfer 4,864 acres of national forest land to Yosemite National Park.

The act of February 17, 1931, 46 Stat. 1166, authorizing the President, upon the recommendations of the Secretaries of the Interior and of Agriculture, to transfer 3,400 acres from the Powell National Forest to the Bryce Canyon National Park, and also authorizing the addition of 1,280 acres to the Powell National Forest.

The act of March 4, 1931, 46 Stat. 1518, transferring to the Wind Cave National Park, S. Dak., 880 acres within the Harney National Forest.

The joint resolution of March 3, 1931, 46 Stat. 1516, authorizing the acquisition by purchase under the Weeks Act of not to exceed 50,000 acres to be added to the Luquillo National Forest, Porto Rico.

Legislation relating to national-forest administration includes

The act of January 31, 1931, 46 Stat. 1053, providing for approach roads to national parks, and that where such roads are within a national forest the Secretary of the Interior shall secure the approval of the Secretary of Agriculture before construction begins.

The act of January 31, 1931, 46 Stat. 1052, entitled "An act to facilitate and simplify the work of the Forest Service," which authorized the Secretary of Agriculture:

(1) To hire or rent property from employees of the Forest Service for use of other officers of the service whenever in the public interest, with limitation of the aggregate amount that may thus be paid permanent employees any one year to \$3,000, exclusive of fire-emergency obligations.

(2) To provide forage, care, and housing for animals, and storage for vehicles and other equipment obtained by the Forest Service for the use of that service from employees.

(3) To reimburse employees of the Forest Service or other owners for loss, damage, or destruction of horses, vehicles, and other equipment obtained by the Forest Service for its use, with payment of the reimbursement from the applicable appropriations for the Forest Service; but except for fire-fighting emergencies no reimbursement amounting to more than \$50 may be made unless there was a written contract of hire or lease.

The joint resolution of February 20, 1931, 46 Stat. 1200, extending to Territories the benefits of the fire-protection provision of the Clarke-McNary Act.

Public Resolution, approved March 3, 1931, 46 Stat. 1516, authorizing the Secretary of Agriculture to cooperate with appropriate officials of Porto Rico under sections 1, 2, 6, and 7 of the Clarke-McNary Act.

The act of February 14, 1931, 46 Stat. 1115, providing that lands covered by special-use permits, in tracts not exceeding 160 acres, in the San Bernardino and Cleveland National Forests, are not subject to appropriation, entry, alienation, or adverse use unless such permit is revoked.

The act of February 16, 1931, 46 Stat. 1163, amending the act of June 2, 1930, by removing the requirement that the memorial to Theodore Roosevelt therein provided for should take the form of an archway, and eliminating the requirement that the memorial shall be completed during the year 1930.

The act of February 20, 1931, 46 Stat. 1196, authorizing the construction at Alameda, Calif., of a building required by the Bureau of Public Roads, Forest Service, and Coast Guard, and also authorizing an appropriation of \$800,000 for carrying out the provisions of the act.

The act of March 2, 1931, 46 Stat. 1468, authorizing a 10-year cooperative program for control of predatory and other wild animals on national forests and other areas of the public domain.

PROGRESS IN STATE FORESTRY LEGISLATION

Illinois passed a law authorizing Federal land acquisition for national-forest purposes; Alabama reenacted the enabling act to the same end, which its codified statutes had omitted through error; and Idaho, South Dakota, and Washington authorized counties to make over lands to the Government for additions to the national forests. The South Dakota law concerned lands acquired through tax-sale procedure, and the Idaho law contemplated the exchange of lands for Federal stumpage.

Arkansas created a State forestry commission with authority to appoint a State forester, but made no appropriation for the work; while Minnesota reorganized its conservation activities by combining under a conservation commission of five members, all appointed by the governor, the former offices of forestry and fire prevention, of game and fish, of drainage, and of conservation, together with the former functions of the State auditor with respect to the public lands, timber, waters, and minerals of the State. A commission of conservation, appointed by the commission, is the administrative

head of the department and appoints the directors of its four divisions—forestry, drainage and waters, game and fish, and lands and minerals. The director of the division of forestry has charge of the administration of all State forests and lands acquired or set apart for forestry purposes, of all sales of State timber, and of all State parks, and is empowered and required to classify all the State lands and determine which shall be administered for forestry and which for agricultural or other purposes.

Minnesota also strengthened and minutely detailed the provisions for the control, maintenance, and management of her State forests; withdrew from sale and added to them certain State school and other public lands; ordained that certain lands reverted to the State after previous sale shall likewise be added; and, with a view to relieving the tax situation in certain counties and preventing default on their bonded indebtedness, authorized the acquisition of certain lands to be administered by the State for forestation, flood control, or other public purposes.

Montana authorized the exchange of State timberlands for similar lands in private ownership. This will enable the State to block up many thousands of acres of its scattered timber holdings into compact State-forest units. Delaware authorized the forestry department to acquire land for State forests, and also to sell or exchange such acquired lands when advantageous to the State's forest interests. Colorado provided for the creation of a State forest and authorized the exchange of State for Government lands. New York extended the Adirondack Park, making it the largest public park in the United States. All of the State-owned land within the park is forest-preserve land, and under the State constitution is forever protected against timber cutting. The life of the New York legislative reforestation commission was again extended for one year.

New Hampshire empowered the forestry commission to receive land for State forests and reservations, and made provision for receiving donations for forestry purposes into a fund to be disbursed in accordance with the donors' stipulations for purposes approved by the State forester. Rhode Island empowered the State commissioner of agriculture, with the approval of the governor, to accept gifts of property for general forest demonstration and experimentation purposes; provided for receiving gifts of money or securities to be used in promoting the practice of forestry on State-owned demonstration forests; and removed the limitation which had restricted the forestry expense appropriation to a small maximum amount. Rhode Island also revised its tree-warden legislation. Oregon provided that county tax-delinquent lands may be surrendered to the State, which will pay the counties 5 cents per acre annually and 12½ per cent of all revenues from the land. Michigan provided for the establishment and management of county, township, city, village, and school-district forests, and for the sale of State lands for these purposes.

Minnesota and North Carolina authorized State forest nurseries; in Minnesota the planting stock produced is for use on State-owned lands only, but in North Carolina stock not required in the State forests may be sold to landowners. Wisconsin made it a misdemeanor to resell planting stock obtained from the State nursery.

Much State forest-fire legislation was revised. To cite only some instances: Connecticut increased the authority of the State fire warden and authorized the governor to close the woods in times of extreme fire hazard to all people except the landowners or their agents. Both Connecticut and New Hampshire made it a penal offense to throw burning substances where they may cause forest fires, and Washington required the equipment of public conveyances with receptacles for such substances. Delaware provided a fire-protective organization and gave fire wardens authority to call on any citizen to assist in fire fighting. Indiana gave the department of conservation authority to protect lands from forest fires, with payment of the cost out of the State forestry fund. Vermont altered its fire-warden legislation with a view to securing greater stability and better performance. Montana insured better fire-prevention and slash-disposal methods by requiring portable sawmill operators to obtain a license permit for each mill site on forest lands, and amended the slash-disposal law so that it can be better enforced. New Mexico required the disposal of slash and débris within 100 feet of railroad rights of way and State or county roads and made failure a penal offense. South Dakota and Nevada provided for cooperation of Federal and State agencies in forest-fire prevention and suppression. Oregon prohibited the extraction of pitch on forest land without a special permit from the State forester, and the Georgia Legislature passed a resolution calling upon judges to charge grand juries on the evils of forest fires and bring to their attention the penalties prescribed by law for illegal burning off of woods.

The Governor of Oregon was given authority to close certain areas during hazardous fire periods to all forms of use, or to make entry subject to permit involving compliance with certain regulations. The Minnesota director of forestry was authorized to prohibit or restrict the taking of brook trout in the forest areas of the State during times of forest-fire hazards, with violations punishable as misdemeanors. The Governor of Maine may now suspend the open season on hunting or fishing in time of drought for such time and in such sections of the State as he may designate; the former law made it necessary that such closing apply to the entire State. The Governor of Vermont may now close the fishing season by reason of drought in the same manner in which he was already empowered to close the hunting season. Wisconsin permits the governor to close or postpone open seasons in case of an extreme fire hazard.

In Oregon both the State and Federal Governments were given the same protection afforded to private owners against trespass for the purpose of cutting trees.

The most notable forest-tax legislation of the year was enacted by Washington. For all lands classified by the State as reforestation lands an annual-assessment value is prescribed, while the timber is maturing, of \$1 per acre if the lands lie west and 50 cents per acre if they lie east of the summit of the Cascade Mountains, with a yield tax of 12½ per cent of the market value of the timber or forest crop when cut. An amendment to the constitution making this act possible was adopted by the people at the last general election. Washington and Oregon now have very similar reforestation laws except that the Oregon law levies the tax at a flat rate of 5

cents an acre on a state-wide basis. In both States the owner is required to provide protection of the land from fire, and all lands suitable to classification as forest land come under the provisions of the law.

New York reduced from 20 to 15 acres the minimum size of tracts of land eligible for classification as reforestation land for tax purposes, and made eligible for such classification natural stands of immature timber as well as planted stands. New Hampshire readjusted the abatement of State taxes to towns containing Federal or State forest lands and discontinued their county-tax abatement. Delaware gave reforesting lands complete tax exemption for 30 years, after which the lands are made subject to the general property tax. Michigan amended its forest-tax law in several particulars, including a reduction in the yield tax from 25 to 10 per cent of the stumpage value. Wisconsin amended the 1929 law, clearing up an obscurity relative to the payment by the State to the counties of 10 cents per acre annually on county lands entered under the forest-crop law, and also passed an act to prevent the removal of timber from lands upon which tax certificates are held by the county, and which to a large extent will eventually become county forests after tax deed is taken.

The New York constitutional amendment to authorize the expenditure of \$19,000,000 for the acquisition and reforestation of land, the management of forests, and the establishment of forest-tree nurseries therefor, has passed the legislature a second time and will be submitted to popular vote at the general election this fall. Minnesota's constitutional amendment authorizing the exchange of State for Federal lands as the legislature may provide will be submitted to the electors at the general election in 1932.

WORK OF THE YEAR IN STATE COOPERATION

Federal appropriations for cooperative work with the States during the year compared with those for 1930 and 1932 are shown in Table 2.

TABLE 2.—*Appropriations for State cooperation, 1930-1932*

	Amount appropriated for fiscal year—		
	1930	1931	1932
For the prevention and suppression of forest fires and for the forest-taxation inquiry (secs. 1 to 3 of the Clarke-McNary law)	\$1,400,000	\$1,700,000	\$1,775,000
For the distribution of forest planting stock to farmers (sec. 4 of the same law)	83,000	93,000	95,000
For farm-forestry extension (sec. 5 of the law, administered by the office of cooperative extension work)	65,000	70,000	74,000

The results of the work are summarized below, except for the taxation study, which is covered on page 61. Table 3 shows in detail the Federal, State, and private funds disbursed by the States or expended under their supervision for the prevention and suppression of forest fires, and the Federal and State funds disbursed by the States for the production and distribution of planting stock.

TABLE 3.—*Cooperative expenditures for fire protection and for the distribution of forest planting stock under the Clarke-McNary Act, fiscal year 1931*

State	For fire protection				For the distribution of forest planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Alabama.....	\$51,569.99	\$16,753.97	\$38,069.45	\$106,393.41	\$736.10	\$736.10	\$1,472.20
California.....	154,575.00	¹ 53,094.49	¹ 334,051.48	¹ 541,720.97	762.00	764.25	1,526.25
Colorado.....					1,990.51	1,990.51	3,981.02
Connecticut.....	12,963.00	70,272.38	1,712.06	84,947.44	2,000.00	2,793.83	4,793.83
Delaware.....	1,080.00	2,378.73		3,458.73	2,000.00	4,232.00	6,232.00
Florida.....	76,230.00	35,468.95	46,273.36	157,972.31	2,000.00	2,521.24	4,521.24
Georgia.....	44,670.53	17,293.42	27,377.11	89,341.06	1,400.00	1,400.00	2,800.00
Hawaii.....					4,000.00	15,918.82	19,918.82
Idaho.....	65,679.00	46,706.05	114,965.13	227,350.18	900.00	965.68	1,865.68
Indiana.....	5,500.00	5,636.98		11,136.98	3,210.00	20,737.94	23,947.94
Iowa.....					2,000.00	2,059.51	4,059.51
Kansas.....					2,165.00	5,471.00	7,636.00
Kentucky.....	16,138.70	16,138.70		32,277.40	2,120.00	2,267.11	4,387.11
Louisiana.....	48,306.00	47,222.42	43,130.12	138,658.54	1,775.78	1,775.79	3,551.57
Maine.....	54,505.00	173,932.36		228,437.36	807.83	807.82	1,615.65
Maryland.....	10,289.00	59,280.09	283.75	69,852.84	2,170.00	5,023.80	7,193.80
Massachusetts.....	30,127.00	98,505.73		128,632.73	3,090.00	5,622.65	8,712.65
Michigan.....	135,351.00	768,207.00		903,558.00	2,710.00	5,783.68	8,493.68
Minnesota.....	103,205.00	470,812.96	28,187.18	602,205.14			
Mississippi.....	32,527.96	17,598.25	14,929.69	65,055.90	311.21	311.21	622.42
Montana.....	26,819.00	16,163.42	55,197.56	98,179.98	2,479.99	5,629.80	8,109.79
Nebraska.....					3,550.00	11,802.00	15,352.00
New Hampshire.....	17,312.00	40,091.85	6,726.07	64,129.92	2,850.00	3,167.08	6,017.08
New Jersey.....	20,492.00	130,196.43		150,688.43	3,770.00	12,023.10	15,793.10
New Mexico.....	2,478.08	2,762.00	1,900.00	7,140.08			
New York.....	70,615.00	281,550.42		352,165.42	4,000.00	44,965.97	48,965.97
North Carolina.....	56,880.00	55,020.02	9,242.93	121,142.95	2,335.00	2,471.11	4,806.11
North Dakota.....					2,660.00	4,245.90	6,905.90
Ohio.....	7,162.00	21,485.17		28,647.17	3,230.00	25,820.55	29,050.55
Oklahoma.....	15,705.00	10,571.88	12,014.00	38,290.88	2,225.00	3,607.46	5,832.46
Oregon.....	104,325.00	57,566.81	223,292.12	385,183.93	1,851.23	1,851.24	3,702.47
Pennsylvania.....	51,151.00	715,123.16		766,274.16	4,000.00	18,054.88	22,054.88
Porto Rico.....					2,990.00	8,854.94	11,844.94
Rhode Island.....	2,267.00	6,631.01		8,898.01			
South Carolina.....	34,020.00	15,003.73	19,669.44	68,693.17	2,000.00	5,842.86	7,842.86
South Dakota.....	1,125.00	3,196.57		4,321.57			
Tennessee.....	23,719.00	18,334.30	7,323.14	49,376.44	2,600.00	2,929.84	5,529.84
Texas.....	39,685.00	38,226.11	14,493.51	92,404.62	1,300.00	1,300.00	2,600.00
Utah.....					2,890.00	3,661.80	6,551.80
Vermont.....	7,794.00	7,545.40	3,941.95	19,281.35	2,280.00	4,221.81	6,501.81
Virginia.....	36,530.00	128,085.23	10,729.95	175,345.18	2,000.00	4,221.81	6,501.81
Washington.....	96,080.00	82,332.31	71,737.40	250,149.71	2,000.00	2,813.22	4,813.22
West Virginia.....	33,414.00	73,811.33	15,863.42	123,088.75			
Wisconsin.....	46,613.00	307,310.05		353,923.05	1,785.00	1,945.77	3,730.77
Wyoming.....					1,570.00	1,698.51	3,268.51
Administration and inspection.....	83,038.42			83,038.42	2,283.51		2,283.51
Total.....	1,619,941.68	¹ 3,910,309.68	¹ 1,101,110.82	¹ 6,631,362.18	90,798.16	248,090.78	338,888.94
Forest taxation and insurance study.....	78,740.95						
Unexpended balance.....	1,317.37				2,201.84		
Total appropriation.....	1,700,000.00				93,000.00		

¹ Incomplete. Final data for State and private expenditures in California not available at time of compilation.

Additional expenditures were made independently, by private individuals, associations, and counties; \$343,000 was reported for the calendar year 1930. The actual expenditure was much larger.

COOPERATIVE PROTECTION OF STATE AND PRIVATE FOREST LANDS FROM FIRE

In the calendar year 1930 approximately 228,000,000 acres of State and private forest or potential forest lands were reported by the States as under some form of systematic protection from fire. This was 55 per cent of the total acreage classed as needing such

protection. A gain of approximately 50,000,000 acres in the area protected has been made since 1925, of which approximately 4,000,000 acres was added during the year. Of the approximately 189,000,000 acres of forests or potential forest land which still remained unprotected, 151,000,000 acres, or 80 per cent, was in the Southeastern and Gulf States. In these States 59,000,000 acres, or 28 per cent of the total classed as needing protection, was under some form of organized protection, with a total expenditure of \$1,176,417, or nearly 2 cents per acre. The States contributed \$455,085, private owners \$251,793, and the Federal Government \$469,539.

While increased financial support for the work is badly needed, it is encouraging, in view of the business depression, that no State gave up its forest-fire-protection work last year on account of reduced available funds. The amount spent by all State and private owners was \$994,000 more than in 1929, mainly because of the extremely severe fire season in many States during the 1930 summer drought. Retrenchment in State and private expenditures for the fiscal year 1932 is in prospect.

The American Forestry Association completed, on June 30, its Southern forestry education project, conducted in Mississippi and Florida for 3 years, in Georgia for 2, and in South Carolina for 1 year. Renewal of the undertaking for another 3-year period was found to be impracticable because of the difficulty in obtaining funds during the business depression. This educational work has been a valuable stimulus to forest protection in the South.

A report on forestry and forest fires in Arkansas embodying the results of the survey mentioned in last year's annual report was transmitted to the Governor of Arkansas in August, with accompanying recommendations for the establishment of a State forest service supported by an adequate appropriation. The report was published by the Arkansas Agricultural Extension Service and received wide distribution. In the spring of 1931 a law was passed creating a State forestry commission and providing for cooperation with the Federal Government in forest protection, but no money has yet been appropriated for the work.

Cooperation with Missouri and Illinois in forest protection was temporarily discontinued. Cooperation with Porto Rico and Hawaii was made possible through an amendment of the Clarke-McNary law extending to them the provisions of sections 1, 2, and 3. A forest-fire cooperative agreement with Nevada was entered into following State legislation which opened the way for it. The work will begin in the fiscal year 1932.

The cooperating States and the district forest inspectors assigned to Clarke-McNary law cooperation in the East assisted in the revision of basic data relating to the forests of the country undertaken by the branch of research, and still under way.

The total area reported as burned by forest fires in the calendar year 1930, on lands protected by the States or the Forest Service, was 5,809,000 acres (inclusive of 1,021,000 acres of nonforest land), as against 4,876,000 acres in 1929; and on unprotected forest lands, 46,457,000 acres as against 41,354,000 acres in 1929. The data for the unprotected lands are too fragmentary and inexact to serve as more than rough estimates. Of the total area reported as burned over in the calendar year 1930, 90 per cent was nonprotected land. Within

protected units 4,788,000 acres of actual or potential forest land were reported as burned over, or 1.44 per cent of the area of such land protected. The drought resulted in unusual fire occurrence and damage during the summer months in the States most severely affected.

COOPERATION WITH STATES IN TREE PLANTING

Approximately 26,000,000 young forest trees were distributed to farmers from the nurseries of the 37 States and of Hawaii and Porto Rico cooperating under section 4 of the Clarke-McNary law. This provided for timber or windbreak planting on more than 26,000 acres of farm lands. The number of trees distributed was 2 per cent greater than in 1930.

The potential demand would justify a much greater production, were greater financial support made available. Cooperation was temporarily discontinued in Missouri and West Virginia. The Forest Service seed collection and extraction plant on the Chippewa National Forest, mentioned in previous reports, supplied to 12 States 3,985 pounds of Norway pine seed at \$4.25 a pound, 498 pounds of white pine seed at \$2.25 a pound, and 18 pounds of white spruce seed at \$6 a pound. This accomplished a material saving in seed cost.

The expenditures of Federal and of State funds during the year are shown for each State in Table 3.

COOPERATION WITH STATES IN FARM-FORESTRY EXTENSION

The establishment of young forests on the lower grades of farm land by planting nursery-grown seedlings and the management of farm woodlands so that they make increased returns are the leading projects in the broad program of farm-forestry extension for the States. In these projects 5,469 plantings for timber growing and 3,872 windbreak plantings were made during the year, and 6,010 farmers were assisted in woods management. New York and Pennsylvania continue to lead in the number of trees planted on farms. Other projects are measuring and estimating timber, protection from fire and diseases, and cutting and marketing timber products. In these 10,087 farms were reached.

Farm-forestry extension is conducted as a part of the program of the various State colleges of agriculture. Federal cooperation in this work is administered by the Extension Service of the Department of Agriculture, with the cooperation of the Forest Service. Most of the Federal appropriation of \$70,000 was used in the employment of State extension foresters, who are the leaders in the extension programs in farm forestry in the 32 States and 2 Territories cooperating under section 5 of the Clarke-McNary Act. The local field workers include county agricultural agents, 4-H club leaders, and a few home demonstration agents.

The 4-H club activities in forestry continue to show substantial increases. Thirty-one States are carrying on this type of junior forestry work with a total enrollment of 6,826 boys and 2,068 girls. Forest planting, woods care and management including fire protection, and timber estimating make up the specific projects. They were applied last year on 11,297 acres. In the Southern States the junior projects in forestry, as in all other lines, are largely based upon the

idea of money-making or investment, while in the Northern States they are more often of purely educational aim. The junior forestry work is growing relatively faster than is the senior branch of the forestry program.

NATIONAL-FOREST ADMINISTRATION

The expenditures for national-forest administration, protection, improvement, reforestation, and extension, totaling \$31,848,613.81, are shown in detail on page 80.

The appropriations of Federal funds for the national-forest enterprise in the fiscal years 1930, 1931, and 1932 are shown in Table 4.

TABLE 4.—*Appropriations of Federal funds for the national-forest enterprise, 1930-1932*

Item	1930	1931	1932
General expenses of administration, protection, and improvement.....	\$7, 527, 730. 00	\$7, 618, 460. 00	\$7, 809, 880. 00
Specifically for:			
Fire control.....	3, 450, 000. 00	1, 420, 000. 00	150, 000. 00
Improvements, tree planting, land and resource surveys, and land adjustments.....	1, 101, 050. 00	3, 210, 620. 00	2, 866, 440. 00
Land acquisition.....	2, 000, 000. 00	2, 000, 000. 00	2, 000, 000. 00
Roads and trails (construction and maintenance) needed primarily for forest protection and development.....	3, 625, 855. 89	6, 671, 023. 72	3, 496, 243. 59
Highway construction and maintenance primarily to meet public needs, as a recognition of Federal responsibility created by ownership of untaxed lands.....	4, 500, 000. 00	11, 000, 000. 00	9, 500, 000. 00

The first three items in column 2 of Table 4 are greater, respectively, by \$141,230, \$1,270,000, and \$255,120 than the corresponding sums reported last year; and the last two items are greater by \$3,000,000 each. These increases were brought about through the passage of the emergency construction act of December 21, 1930. The first item was increased by \$100,000 as the result of the emergency appropriation for insect-infestation control carried by the act of February 6, 1931, and a deficiency appropriation to take care of salary increases under the Brookhart Act added \$47,630 more. On the other hand a decrease of \$6,400 took place through a smaller final allocation of equipment and supply funds than that used in making up the statement last year.

The increase in the second item took place through a deficiency appropriation of \$1,270,000 to replenish funds drawn upon for fire-fighting expenditures in excess of the small amount appropriated in advance for this purpose. As has been explained in earlier reports, this is an established procedure, since the amount that will be required can not be foreseen and varies greatly from year to year.

The increase in the third item is made up of \$254,800 derived from the emergency construction act of February 6, 1931, and \$320 derived from the deficiency appropriation to meet salary increases under the Brookhart Act.

The difference between the amounts appropriated for 1932 and the corresponding amounts appropriated for 1931 are accounted for as follows:

The first item was increased by \$141,420 through a considerable number of minor provisions made in the regular agricultural appropriation act for the enlargement of various activities. It was further increased by \$150,000 through a deficiency appropriation of this amount, made available for blister-rust control in both 1931 and 1932, but all held for expenditure in the latter year. On the other hand, a partially offsetting decrease of \$100,000 was due to the fact that the emergency appropriation for insect-infestation control made available in 1931 under the act of February 6 of that year, as mentioned above, had no 1932 equivalent.

The difference in the second item, between the 1931 and the 1932 appropriations for fire control, is due to the method already explained, under which the costs of fire fighting are met chiefly through deficiency appropriations. The 1932 amount is the usual sum provided in advance. In point of fact, under the terms of the appropriation, two-thirds of it becomes available immediately upon passage of the act and in consequence of an unprecedentedly early beginning of the fire season in the spring of 1931 was actually all spent before the fiscal year 1932 began.

The decrease of \$344,180 in the third item was principally due to the deficiency construction increase of the 1931 item already mentioned, amounting to \$254,800. The agricultural appropriation act increased the sum provided for planting by \$25,000, for range improvements and for administrative improvements by \$20,000 each, for camp-ground improvements by \$10,000, for land adjustments \$6,480, and for resource surveys \$9,940. For protection improvements (including protection roads and trails) an addition of \$240,000 was contemplated when the agricultural appropriation bill was first drafted; but since the emergency construction legislation provided for much more extensive road building in 1931 than had previously been scheduled, the 1932 protection improvements item was reduced by \$180,800 in place of receiving the contemplated increase.

A decrease of \$174,780.13 in the 1932 provision for "roads and trails needed primarily for forest protection and development" was in consequence of the smaller receipts from the national forests in 1931, as is shown on page 82. Under a continuing appropriation, 10 per cent of the receipts of each year becomes available for road construction and maintenance the following year. The rest of the decrease in this item was due to the fact that the emergency construction \$3,000,000 added to the original 1931 appropriations for forest-development roads has no counterpart in the 1932 appropriation. In the case of the forest-highway appropriation, however, a sufficient increase was provided through appropriations made for this purpose outside the emergency legislation to make the net decrease in the final item only \$1,500,000 instead of \$3,000,000.

THE NATIONAL-FOREST PROPERTIES

The gross area of the national forests on June 30, 1931, was 185,251,582 acres, of which 24,463,895 acres were in ownerships other than that of the United States, making the net area 160,787,687 acres. During the year the gross area increased 1,275,652 acres and the net area 696,870 acres.

Area recomputations based on better surveys and land data reduced the gross area 1,237 acres; eliminations by presidential proclamations or Executive orders, 43,041 acres; eliminations by acts of Congress, 34,880 acres; and State selections under land-exchange agreements, 11,748 acres. On the other hand, presidential proclamations and Executive orders added 992,739 acres, acts of Congress 343,740 acres, land exchanges 30,029 acres, and gifts 50 acres. Table 5 shows the changes in detail.

TABLE 5.—*National-forest gross area changes, fiscal year 1931*

National forest	State	Additions	Eliminations
		<i>Acres</i>	<i>Acres</i>
Arapahoe.....	Colorado.....		¹ 14,597
Ashley.....	Wyoming.....	² 40,289	
Bitterroot.....	Montana.....	³ 152	
Black Hills.....	South Dakota.....	³ 399	
Black Hills.....	Wyoming.....	³ 289	
Boise.....	Idaho.....	² 299,113	
Chugach.....	Alaska.....		¹ 39
Crook.....	Arizona.....		¹ 118
Custer.....	Montana.....	³ 240	
Custer.....	South Dakota.....		⁴ 2,114
Deerlodge.....	Montana.....		¹ 8,319
Harney.....	South Dakota.....	³ 1,642	² 880
Hiawatha.....	Michigan.....	¹ 271,014	
Kisatchie.....	Louisiana.....	¹ 229,526	
Kootenai.....	Montana.....	³ 3,419	
Lolo.....	Montana.....	³ 740	
Marquette.....	Michigan.....	¹ 239,347	
Missoula.....	Montana.....	³ 327	
Olympic.....	Washington.....		⁴ 4,967
Ottawa.....	Michigan.....	¹ 252,551	
Pike.....	Colorado.....	² 80	
Powell.....	Utah.....	² 1,267	¹ 19,424
Rainier.....	Washington.....		² 34,000
Shasta.....	California.....	³ 160	
Sitgreaves.....	Arizona.....	⁵ 10	
Siuslaw.....	Oregon.....	⁵ 40	⁴ 846
Snoqualmie.....	Washington.....		⁴ 3,661
St. Joe.....	Idaho.....		⁴ 160
Tahoe.....	California.....	³ 7,786	
Tongass.....	Alaska.....	¹ 301	¹ 544
Unatilla.....	Oregon-Washington.....	³ 320	
Washakie.....	Wyoming.....	² 2,991	
Wenatchee.....	Washington.....	³ 327	
Whitman.....	Oregon.....	³ 14,228	
Total.....		¹ 1,366,558	89,669

¹ Made by presidential proclamation or Executive order.

² Made under acts of Congress.

³ Private lands acquired through exchange.

⁴ Made through State selections of exchange lands.

⁵ By gift.

The additions to the Ashley, Boise, Powell, and Washakie National Forests were made under specific acts of Congress. The Ashley addition involved lands important not only for timber production but also as parts of the watershed of the Hoover Dam. The Boise addition comprises important parts of the watershed of the Arrowrock Reservoir of the Boise reclamation project, where destructive erosion has affected the stream flow and caused heavy sedimentation of the reservoir. The Powell addition was a transfer from the Bryce Canyon National Park of lands not needed for park purposes, and the Washakie addition placed under management a small area of valuable timberland.

The Hiawatha, Marquette, and Ottawa additions in Michigan and the Kisatchie addition in Louisiana represent the conversion of previously established purchase areas into new national forests.

The three largest eliminations transferred lands from the Arapaho, Powell, and Rainier National Forests to the Rocky Mountain, Bryce Canyon, and Mount Rainier National Parks, and the small elimination from the Harney National Forest was transferred to the Wind Cave National Park. One elimination involved lands found not to be chiefly valuable for national-forest purposes. In Alaska two small eliminations were made to facilitate entries of lands for purposes of trade, manufacture, or residence.

Shortly before the fiscal year began the chairman of the commission on the conservation and administration of the public domain requested from the Forest Service such data as it had or could obtain regarding the unappropriated and unreserved public lands of the United States. The character of the national-forest organization and its close touch with the public lands made it possible to assemble a large volume of physical and economic data. Reports and maps were transmitted to the chairman of the commission November 8, 1930, and members of the Forest Service later appeared before the commission and presented further information. In substance, the reports of the field officers indicated that of the remaining unreserved public lands approximately 19,000,000 acres is of enough importance for timber production or watershed protection to warrant its inclusion within national forests, together with 1,900,000 acres of intermingled State and 13,600,000 acres of intermingled private lands. While more detailed studies might somewhat change the amounts, it seems evident that much land remains in Federal ownership which might appropriately be placed under national-forest management.

LAND ACQUISITION THROUGH EXCHANGE

The authority to exchange national-forest land or stumpage for State or privately owned lands within and in some instances adjacent to the national forests creates both an opportunity and a responsibility. Consolidation affords an opportunity to increase the public value of the properties and to protect and manage them more economically and effectively. At the same time exchanges can contribute materially toward solving the problems of land economy that are assuming alarming proportions in some of the national-forest regions.

Duplication of effort, uncoordinated control over integral holdings, lack of unity in utilization programs, and waste of various kinds can be greatly reduced by bringing into compact holdings the different classes of lands now of widely diffused and intermingled public and private ownerships. The national forests contain 24,463,895 acres of State and private lands. Adjoining their boundaries are additional millions of acres valuable chiefly for timber production and actually integral parts of the forest areas. Probably from 15,000,000 to 18,000,000 acres of this intermingled or contiguous land is most valuable for timber production or stream-flow conservation. Each year a considerable acreage is logged and thereupon becomes an economic, political, and social problem; economic in that to keep it

productive will involve substantial current outlays in the face of long-deferred returns; political in that its contribution toward the costs of local government is sharply reduced if not wholly eliminated, and social in that it will not for a long time help to maintain communities. The rising curve of tax delinquency carries a serious and widespread menace to local security and permanence.

Some of the Western States are moving toward programs of State-forest management, but multiplying demands upon their financial resources raise sharp question as to how far they will be able to go in undertaking the protection and redemption of the very large amounts of cut-over lands that are accumulating. Some private owners have made earnest efforts to conserve the productivity of their logged-off lands, but the economic situation is at present unfavorable to such efforts, and in numerous instances they have been abandoned. Inevitably the public interest will require placing much additional land under national-forest management, through exchange or donation. A vast problem of ways and means will arise. More liberal use of national-forest timber for acquiring land through exchange would adversely affect county finances by curtailing the amounts paid the counties out of receipts from national-forest timber sales. It seems worth while to suggest again the desirability of employing some part of the unreserved public lands, through exchanges, as a means toward meeting the problem.

Progress was made toward the consummation of two additional exchanges with the State of Michigan which will transfer to the national forests some 90,000 acres of State lands within them and give the State an approximately equal area of unreserved Federal lands adapted to State forest management. An exchange of this character can be made in Michigan under provisions of a law enacted July 31, 1912 (37 Stat. 214) relating to selection of public lands by that State. Progress also was made in further exchanges with the State of South Dakota. In Colorado the area tentatively considered for selection by the State in exchange for school sections now widely scattered throughout the national forests was cruised and appraised, but no final action was taken. The State of Montana indicated a desire to enter into further exchanges to block up its State forests. Earlier exchanges with other States were carried further by the clear listing of additional State selections.

During the calendar year 1930 reconveyances to the United States of 225,075 acres of private lands in exchange for 55,551 acres of national-forest land and 180,976,000 board feet of national-forest stumpage, valued at \$432,274, added a net 169,524 acres to the forests. The Secretary of Agriculture approved and referred to the Secretary of the Interior for further action 157 new cases, offering 304,906 acres of privately owned land in exchange for 30,890 acres of national-forest land and \$570,844 worth of national-forest stumpage. In all, to December 31, 1930, 691 land-exchange cases have been consummated. Through them the United States has acquired 1,005,598 acres of land, valued at \$4,119,299, in exchange for 291,627 acres of national-forest land, valued at \$1,538,149, and 768,563,000 board feet of national-forest stumpage, valued at \$2,096,789. Besides the net gain of 713,830 acres in national-forest area, the volume of stumpage on the acquired lands is much greater than that surrendered.

Table 6 shows the progress and results of the land-exchange work to the close of the calendar year 1930.

TABLE 6.—Number of land-exchange cases consummated up to December 31, 1930

State	Number	Land conveyed to the United States		Selected land granted in exchange		Timber granted in exchange	
		Area	Appraised value	Area	Appraised value	Volume	Appraised value
		<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>	<i>Dollars</i>	<i>M board feet</i>	<i>Dollars</i>
Arizona.....	22	164, 278	293, 837	8, 824	19, 367	104, 479	255, 18
Arkansas.....	3	27, 448	48, 119	146	1, 030	5, 752	46, 02
California.....	73	159, 297	1, 327, 534	22, 424	447, 587	201, 763	636, 82
Colorado.....	136	64, 014	263, 052	17, 264	53, 509	54, 467	156, 92
Florida.....	11	55, 917	116, 562	21, 015	42, 181	12, 514	72, 78
Idaho.....	56	52, 686	127, 770	10, 621	51, 499	10, 142	63, 68
Michigan.....	10	61, 221	86, 597	60, 575	85, 862		
Minnesota.....	15	2, 614	16, 298	26	16	2, 340	12, 22
Montana.....	75	119, 271	246, 950	72, 189	168, 168	21, 788	63, 15
Nebraska.....	1	8, 960	44, 800	8, 959	44, 793		
New Mexico.....	30	66, 146	278, 098	7, 715	12, 880	106, 074	255, 12
North Carolina.....	1	71	144	1	15		
Oregon.....	166	148, 330	937, 710	41, 460	504, 773	173, 201	364, 49
South Dakota.....	16	3, 589	13, 609	338	1, 632	1, 836	7, 14
Tennessee.....	1	14	70		1		
Utah.....	26	18, 230	110, 301	18, 307	101, 537		
Washington.....	36	48, 577	186, 530			70, 969	152, 83
Wyoming.....	13	4, 941	21, 318	1, 763	3, 299	3, 238	10, 38
Total.....	691	1, 005, 598	4, 119, 299	291, 627	1, 538, 149	768, 563	2, 096, 78

LAND ACQUISITION THROUGH PURCHASE

Title was taken under the Weeks law, as amended by the Clarke McNary law, to 594,091 acres, at a cost of \$1,869,944.27. Purchase totaling 594,090 acres and creating a total obligation of \$1,943,736.21 were approved by the National Forest Reservation Commission. The average price was \$3.55 per acre for the lands approved for purchase and \$3.15 for the lands actually acquired, as compared with a previous average of \$4.93 for all lands acquired. At the close of the year the average cost of all lands fully acquired, not including overhead, was \$4.66 per acre, the total \$18,688,536.02, and the area 4,007,386 acres, distributed by States as shown in Table 7.

TABLE 7.—Acreage of timberland acquired in the fiscal year 1931, and total acquired to July 1, 1931, by States

State	Acquired in 1931	Average price per acre, 1931	Acquired up to July 1, 1931	State	Acquired in 1931	Average price per acre, 1931	Acquired up to July 1, 1931
	<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>		<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>
Alabama.....	1, 077	5. 44	105, 747	Oklahoma.....	48, 097	1. 40	48, 0
Arkansas.....	36, 761	3. 20	283, 055	Pennsylvania.....	32, 669	8. 16	350, 0
Florida.....	112, 945	2. 87	197, 960	South Carolina.....	3, 330	4. 78	46, 8
Georgia.....	14, 489	5. 73	269, 489	Tennessee.....	2, 771	4. 24	379, 6
Louisiana.....	57, 370	3. 74	66, 983	Virginia.....	5, 287	6. 06	601, 2
Maine.....			33, 482	West Virginia.....	39, 645	4. 64	318, 0
Michigan.....	67, 246	1. 66	211, 973	Wisconsin.....	99, 393	1. 72	114, 9
Minnesota.....	47, 481	2. 04	115, 060				
New Hampshire.....	22, 038	6. 99	482, 792	Total.....	594, 090	3. 15	4, 007, 3
North Carolina.....	3, 491	3. 84	382, 046				

Because of inability to acquire lands under conditions acceptable to the United States, the Vernon purchase area in Louisiana, approved in February, 1928, was abandoned, and a new unit bearing the same name and in the same region was authorized instead. This unit contains a gross area of 107,000 acres, within which it is planned to acquire approximately 75,000 acres. For similar reasons the St. Croix unit, in Pine and Carlton Counties, Minn., authorized December, 1928, was replaced by the Mesaba, in St. Louis County, Minn., containing about 170,000 acres. Permanent boundaries for the Green Mountain unit, Vermont, embracing a gross area of 90,000 acres, were defined and approved, and initial purchases totaling 31,228 acres were authorized. The commission also approved additions of 12,032 acres to the Allegheny area, in Pennsylvania; 6,700 acres to the Natural Bridge area, in Virginia; and 10,819 acres to the Ocala area, in Florida; and certain extensions of the boundary of the Ouachita National Forest in Garland County, Ark. The Mackinac and Keweenaw purchase areas in Michigan were redesignated and proclaimed the Hiawatha and Ottawa National Forests.

As a means of alleviating the effects of drought and agricultural depression the commission approved early in June, 1931, an emergency program for small purchases from farmers and others wishing to sell. It thus authorized 166 separate purchases, aggregating 16,558 acres, at an average price of \$3.18 per acre and a total outlay of \$52,624.82.

An act approved March 3, 1931, extended the purchase provisions of the Clarke-McNary law to Porto Rico. This will permit of desirable additions to the existing Luquillo National Forest. The insular government has offered to donate 1,381 acres of land chiefly valuable for forest purposes.

The wisdom and soundness of the national-forest purchase policy and program initiated by the Weeks law and extended by the Clarke-McNary law seem clearly established. Lands of great public importance as sources of streams and timber supply, which would not otherwise have been protected or constructively managed, are being safeguarded from damage and deterioration and gradually brought to their highest usefulness. They are serving to stabilize dependent industries and communities and are helping to solve local problems of land economy. Their purchase has liquidated frozen assets and so promoted healthier financial conditions in their regions. The administrative and construction activities incident to national-forest management have been locally beneficial, while the Nation has obtained benefits and values commensurate with the costs. There are few ways in which the Federal Government can contribute more toward the working out of social and economic problems relating to land use.

A downward trend in land requirements for future farm crops is in prospect. The time is remote, if it ever comes, when the tillage of additional lands will be necessary. The continued cultivation of submarginal lands is now regarded as manifestly undesirable. The combined problem of submarginal farm land and cut-over or burned timberland grows in magnitude and complexity as the area of these lands increases. Their increase decreases the financial ability of

counties and States to meet the growing demands upon them, through reducing taxable assets and tax incomes. The situation is by nature difficult of successful adjustment by local agencies.

In view of all this, the proposed program of national-forest-land purchase under the Clarke-McNary law is modest. Approximately 375,000,000 acres of land east of the Great Plains are believed to be most valuable for timber production or stream-flow protection, of which 6,827,440 acres are now in Federal ownership. The program proposes an ultimate eastern national-forest area of approximately 16,000,000 acres, or 4.3 per cent of all the forest land. The State foresters have estimated the area which may eventually be included in State forests at 36,666,000 acres, or a trifle less than 10 per cent of the whole forest area, but it is far from certain that the States will be able to administer anything like this total. In any case more than 85 per cent of the forest area would be left dependent upon private initiative for its conservation and management. It is a question whether the acquisition program of the Federal Government should not be appreciably enlarged. That it should be more rapidly carried forward seems indubitable.

SPECIAL USES

The national forests serve a wide variety of miscellaneous uses, commercial, industrial, and recreational, which are compatible with their major purposes, contribute to the economic life of dependent communities and bring about a more complete utilization of the properties. Such uses are regulated through special-use permits. No charge is made for permits to public agencies or when the use is incidental to other forms of use involving a charge; but all permits issued for uses of a commercial or exclusive character involve a reasonable annual charge for the privilege conveyed. The revenues thus obtained defray the costs of administering the special-use business and contribute to the receipts made over to the counties and to the general cost of maintaining and improving the forests.

Most of the special-use permits are revocable licenses. The act of March 4, 1915, authorizes definite contracts for a term of years but for a maximum area of only 5 acres. A maximum of 80 acres would make it possible to secure in certain types of development greater facilities and better service to the public than private investors are now disposed to provide. Another obstacle is the ease with which adverse rights can be established through filing mining locations under the Federal mining laws. Within the Cleveland and San Bernardino National Forests, in California, this situation was remedied by legislation approved February 14, 1931. Similar legislation covering all national forests would promote their best utilization.

At the close of the calendar year 1930, 35,250 special-use permits were in effect, of which 16,634 were free and 18,616 subject to an annual rental charge. The free permits numbered 675 more than in the preceding year and the paid permits 375 more. The receipts totaled \$301,716.49, a slight increase.

CLAIMS AND SETTLEMENT

Where lands within national forests are involved, the reports required by the Department of the Interior as bases of action upon applications for patent under the public land laws are prepared and submitted by the Forest Service. Reports were submitted upon 128 applications for homestead patent. Of these, 115 recommended issuance of patent and 13 were adverse.

Many of the areas classified from 5 to 15 years ago as agricultural and open to entry under the forest homestead act of June 11, 1906, and the classification act of August 10, 1912, have either remained unentered or after a succession of entries and relinquishments have been left unpatented and unoccupied, demonstrating that their classification was erroneous. In the light of present knowledge, the lands clearly are not valuable for agricultural purposes. A considerable number of these listings were recalled during the year.

Of the reports upon applications for mineral patent, or upon mining locations, 80 were favorable and 30 unfavorable. The ratio of unfavorable reports points to an increasing rather than decreasing misuse of the mining laws to acquire valuable land for purposes other than mining. Since the Forest Service began to examine and report on mining claims more than 80 per cent of the reports have recommended issuance of patent. The bona fide development of mineral resources should receive every encouragement, but abuse of the mining laws should be prevented. The need for this is made more acute by the developing plans for the protection of roadside beauty. Following the survey or construction of a new State or Federal highway many mining claims have been located to obtain sites for filling stations, stores, lunch counters, resorts, and the like, or to control land or material needed for the project. Cancellation of such locations, if possible at all, necessitates the expenditure of much official time and effort. Under the prevailing liberal provisions and interpretations of the mining laws negligible indications of mineralization, plus technical compliance with the requirements for discovery and development, frequently permit the establishment of title. The most effective remedy would be so to amend the mining laws as to retain the surface rights in public ownership, subject to unrestricted use by the mineral patentee in the exploitation of mineral values.

COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

As already noted, four transfers of lands from national forests to national parks, aggregating 68,901 acres, were made. Each of these transfers was under a specific act of Congress. The report of the Yellowstone National Park Boundary Commission, recommending transfer of 52,480 acres from the Teton National Forest to the Yellowstone National Park, awaits congressional action.

The Director of the National Park Service also has proposed for interbureau consideration transfer of the so-called Wawona area, the Devil's Postpile National Monument, Mount Banner, Mount Ritter, and the Thousand Island Lake region from the Sierra Na-

tional Forest to the Yosemite National Park; of an area embracing Buchanan Pass, Sawtooth Mountain, Thunderbolt Peak, and Apache Peak, from the Arapaho National Forest to the Rocky Mountain National Park; of the Kings River Canyon area, the Mineral King area, the Redwood Mountain and Redwood Canyon area between Sequoia and General Grant National Parks, and a square mile adjoining the latter park from the Sequoia National Forest to the Sequoia and General Grant National Parks; of the Cedar Breaks area from the Dixie National Forest to the Zion National Park; of the Diamond Lake area and the Anna Creek extension from the Crater National Forest to the Crater Lake National Park; of a part of the area situated between the Grand Teton and Yellowstone National Parks from the Teton National Forest to the Grand Teton National Park; of considerable parts of the Kaibab and Tusayan National Forests to the Grand Canyon National Park; and the inclusion of the Bandelier National Monument and related parts of the Santa Fe National Forest within a new national park. An ultimate study of the suitability for national park purposes of Holy Cross Mountain and Mount Evans, Colo., is tentatively suggested.

The proposals are receiving careful study. Many economic and social values are involved. As parts of national parks the areas would be dedicated exclusively to inspirational and educational purposes, and closed to industrial or commercial utilization. As parts of national forests the natural resources would be open to regulated use, with endeavor to provide also for coordinated utilization of all public values to the extent that available funds, authority, and administrative set-up make possible. The needs and interests of dependent local communities must be carefully weighed. To determine the form of administration which will yield the highest net return in public usefulness calls for judicial and thoroughgoing analysis of many relationships.

NORTHERN PACIFIC LAND-GRANT ADJUDICATION

The legal proceedings authorized by the act of June 25, 1929, to adjudicate the disputed questions of law and fact in relation to the land grant to the Northern Pacific Railway Co. and the equities established by the company under the provisions of that grant, were initiated by the Department of Justice during the year, and the suit has been set for hearing in the Federal court of the Eastern District of the State of Washington. The Forest Service cooperated extensively with the Department of Justice in assembling record and status data, examining and evaluating the national-forest lands involved, reviewing earlier classifications of the lands, and in other essential features of the preliminary proceedings.

PROTECTION FROM FIRE

The national forest fire record is becoming more and more significant as it lengthens. The building up of the present system of organized protection dates from 1910, the first year to bring the Forest Service face to face with the magnitude and complexity of the fire-control problem. The losses of that year were disastrous

far beyond anything ever known either before or since. Because of the extreme variations in rainfall and other weather conditions, both the difficulty of protection and the fire damage fluctuate enormously. Most of the losses take place in the extreme "bad years." Consequently statistical comparisons of successive years disclose little regarding the trend in the effectiveness of fire control. Taken as a whole, however, and considered in connection with the variable introduced by the bad years, the record begins to provide a criterion of substantial importance.

By taking the average of successive 5-year periods instead of the record of each individual year as the basis for comparison, the peaks due to the bad years are rounded off. This works well for the 15 years 1910-1924, when each 5-year period included one of the extreme bad years. The 1925-1929 period, on the other hand, included three bad years. The following comparison of the percentage of the gross area of the national forests burned over annually, by 5-year averages, for all four periods is republished from last year's report:

	Per cent		Per cent
1910-1914-----	0.75	1920-1924-----	0.29
1915-1919-----	.60	1925-1929-----	.33

It would seem a fair interpretation that the 1910-1914 average was so high because of the prodigious area burned over in the first year, when the development of large-scale organization began under the stress of an unexpected and unexampled crisis; that the progressive decline in the percentage of area burned over in the two following periods represents a gradual gain in efficiency under the unremitting effort made to master the problem; and that the rise of the percentage in the fourth period was due to the fortuitous increase from one to three in the number of bad years included.

It is a fact fully established by the weather records that the parts of the West where fire control is most difficult and where most of the great fires occur have suffered in recent years a succession of deficiencies in precipitation, with very severe summer fire conditions. The 1930 season added another bad year to the three that fell in the 1925-1929 period; and the 1931 season, still under way as this report closes, will probably be found when its record is complete to have equaled if not surpassed in the intensity of its adverse conditions the worst ever before confronted by our forest officers.

Of the 1931 area lost it is, naturally, impossible at the present time to attempt to speak except in broad, yet tentative, generalization. That it has already much exceeded the area lost in 1930 appears to be unquestionable. That, considering the conditions confronted, the performance in protection was definitely and demonstrably superior to the best performance of all the past appears to be also unquestionable. In the case of 1930 the record is complete, and ready to take its place along with those of former years. Its addition to the 1925-1929 group increases the number of years to six, and the number of bad years in the period to four. In the difficulties of control this 6-year period was beyond all comparison the worst that the Forest Service has ever gone through. The series of averages listed above may be extended by adding figures for the 6-year average, and also for 1930 singly. The showing for the gross national forest

area burned over in the last three periods of the series so extended was:

	Per cent
1925-1929, average area per year-----	0.33
1925-1930, average area per year-----	.29
1930, total for single year-----	.11

The final entry signalizes the best results in protection yet attained by the Forest Service. The percentage of the gross area burned over has in no year since 1910 been so low. Prior to 1910 single year—1906—had a lower recorded percentage, but it was an incomparably easier year, and the small and inexperienced force of forest officers was unable in those days to record all fires. Measured in terms of damage to national-forest resources the 1930 losses were less than one-fifth of the average for the last six years. At the same time fire-fighting costs were reduced. Table 8 presents the 1930 record in the usual detail.

TABLE 8.—*Comparison of fires on national forests, calendar years 1930, 1929, and 5-year average, 1926-1930*

	Number of fires			Percentage of total		
	1930	1929	Average 1926-1930	1930	1929	Average 1926-1930
Class:						
Burns of 0.25 acre or less-----	4,653	4,105	3,962	55.47	55.11	55.7
Burns between 0.25 and 10 acres-----	2,246	2,040	1,937	26.78	27.39	27.3
Burns of 10 acres and over-----	1,489	1,304	1,210	17.75	17.50	17.0
Total-----	8,388	7,449	7,109	100.00	100.00	100.0
Cause:						
Railroads-----	172	290	286	2.05	3.89	4.0
Lightning-----	4,032	3,499	3,438	48.07	46.97	48.3
Incendiarism-----	1,288	786	764	15.36	10.55	10.7
Débris burning-----	278	305	246	3.31	4.10	3.4
Lumbering-----	118	123	114	1.41	1.65	1.6
Camp fires-----	715	702	680	8.52	9.43	9.3
Smokers-----	1,422	1,429	1,271	16.95	19.18	17.8
Miscellaneous-----	363	315	310	4.33	4.23	4.3
Total-----	8,388	7,449	7,109	100.00	100.00	100.0

Calendar year	Total area of national-forest land burned over	Total damage of national-forest land burned over	Total cost of fighting fire exclusive of time of forest officers
	<i>Acres</i>	<i>Dollars</i>	<i>Dollars</i>
1930-----	137,944	348,890	1,191,13
1929-----	799,082	4,338,755	3,203,16
5-year average 1926-1930-----	456,594	2,076,516	1,680,54

It is believed that on an average losses will continue to shrink. Increasingly the results of the capital investment made in roads and trails are showing up. Along with this, technical skill in management and improvement in organization are steadily increasing. Technics of building the simple roads and trails which give the best service to forest protection have little in common with the construction of highways for general travel. Such roads are now constructed

at rates of cost per mile which would have been considered impossible a few years ago.

Training of the many thousands of fire guards and cooperators is being improved, so that each may function effectively when his individual competence becomes the decisive factor in determining whether a fire is quickly put out or devastates thousands of acres and must be fought for days or weeks by large, hastily organized crews. The ever-present task of impressing millions of users of the forests with the necessity for extreme care in the use of fire is being taken up along new lines, wherever new and promising lines of effort can be found, and with increased intensity of effort everywhere when the necessary funds are available. Measures are being taken to insure that before the start of each season every tool is made ready and every detail of organization and planning brought to the utmost attainable degree of preparedness. Dozens of tools and managerial devices are being employed to speed up the processes of discovering and stopping the spread of all fires. Effort is being focused on the objective of control of every fire before 10 o'clock of the morning after its discovery, regardless of how far or fast it may run initially.

The strength of the forces making for continued fire losses should not be underestimated. The weather seems to have in store an inexhaustible variety of surprise attacks with which to baffle fire executives. Such was the unprecedented spring fire season of 1931 in Oregon, Washington, Idaho, and Montana, where drought, wind, low humidity, and lightning disturbances appeared in April and May, producing a fire danger never before encountered at that time of year. Since the organization was unprepared financially or otherwise to cope with such conditions at so early a date, the forests suffered severely. Industrial, recreational, and other human uses of the forests increase rapidly, and correspondingly the number of what may be called unavoidable accidental fires. An increasing number of national-forest users and visitors come from distant parts of the country, bringing an ever-renewed stream of people ignorant of the need for care with fire and unacquainted with the precautions that are necessary not to set the forests ablaze. The slight decrease in the number of smokers' fires for 1930 as compared with the number in 1929 can not be taken as a sign of greater carefulness on the part of smokers—the fire season was shorter. Destructive logging in the remaining stands of privately owned virgin timber extend the areas of inflammable slash. The record of the next few years will add an important new chapter to the history of the struggle to conserve American forest resources.

What lies ahead in the matter of drought is of course unforeseeable. In general drought has been prevalent in the last decade. Last year the cumulative shortage of precipitation had reached such a point that on some of the western forests even tree growth was dying to an alarming extent. The 1930 shortage of rainfall in a large number of Eastern States brought about a like condition and resulted in a fire season of unprecedented severity and length. The western fire season, however, was shorter than in 1929, and there was relatively little "bunching" of lightning fires, though the total

number of lightning fires was greater than in 1929. The comparative freedom from electrical storms, which sometimes start hundreds of fires on a single national forest within a few hours, contributed much toward making the 1930 record so good.

The favorable 1930 record was, however, chiefly due to the growing number of protective improvements, increased equipment, increasing managerial skill, and increasing public interest and cooperation. Capital investment in low-cost roads and trails, while still proceeding at a regrettably slow rate, has gone far enough to make a real difference in the speed with which fires can be reached and controlled before they can do much damage. Modest increases for the employment of fire guards and other protection personnel and for tools and equipment likewise helped. The mere increase of protective funds, however, does not necessarily produce a corresponding result. Fire control is not a self-working machine into which money can be poured at one end with assurance that good results will emerge at the other. Accomplishments in an enterprise dealing with such an infinite variety of conditions of weather, climate, topography, cover, and culture must depend upon the spirit and ability of human beings. The task is so widely distributed geographically that detailed supervision becomes impossible. The ingenuity, skill, and competence of individual employees must be developed and utilized. The final result in fire control for the national forests as a whole is determined by the competence of many thousands of men, from laborers and fire guards to the regional foresters in charge, each acting under conditions which necessitate individual initiative, judgment, and knowledge. Such an enterprise presents primarily a problem in human engineering, organization, and all the delicate adjustments on which depend effective action when men are necessarily thrown on their own resources, as executives or as single fire fighters, yet must also function with closely adjusted teamwork, in a firmly controlled and at the same time swiftly operating and highly flexible unit. Without the development which has taken place along these lines the 1930 record could not have been attained. Years of effort are yielding worth-while fruit.

The cooperation of literally thousands of communities and organizations and millions of individual citizens is also contributing more and more to effective protection. The conception that the Forest Service is helping the public to protect its own forests is becoming a living reality. Without such cooperation fire prevention and suppression on the national forests could not have reached its present stage of effectiveness.

The winter of 1930-31 continued the dry cycle of recent years, with but few local exceptions. Fire weather of unprecedented severity in the early spring produced serious fires in Oregon, Washington, Idaho, and Montana. In California, the Lake States, and the East early spring fires are usual, but these regions had abnormally bad conditions. Tragic fires occurred at numerous points in the Lake States, and the national forests in that region came in for their share of trouble. Starting in most places about the middle of June, generous and repeated rains over large portions of the regions most

needing rain brought relief which for the West proved merely a breathing spell, to be followed by a summer season which, as has already been indicated, may well prove, when the fall rains permit it to be viewed in retrospect, to have been as crucial a test as the national-forest protective system has ever been subjected to. So far as can be judged at the time of concluding this report (September 1), the test has been met creditably.

USE OF RADIO ON THE NATIONAL FORESTS

The reports for 1928 and 1929 mentioned work under way to discover whether radio can be used in forest protection, as a mobile means of communication with single men or parties engaged in patrolling, scouting, trail building, or fire fighting at remote points and with shifting locations. Some authorities had advised the Forest Service that this was out of the question. Others believed the contrary. No tests of radio had ever been made that afforded a basis for actually determining whether under the special conditions involved an investment in radio equipment would be worth while. Tests to find this out were therefore initiated. The question was whether the interference from rough topography and the absorption of radio energy by trees would preclude the use of radio for the purposes contemplated.

During the field season of 1929 these tests were completed. In the nature of things, portable radio sets must be operated with low power from dry batteries in order to keep the weight of the outfit within practicable limits. It was found that while rough topography and nearness of green tree foliage do interfere very materially with transmission, this is not insuperable if the correct wave length and the most advantageous length, height, and arrangement of antenna are employed and if the portable set is sufficiently simple, sturdy, and reliable to give satisfactory results with men only slightly trained.

In carrying on the tests it was necessary to make numerous designs of radio instruments, with the result that incidentally the specifications of a portable radio set which promised to meet the requirements were produced. A model constructed under these specifications was given criticism by radio experts. A few duplicate sets were then constructed under contract, and seven were used on the Columbia National Forest during the fire season of 1930. They weighed 79 pounds each, including batteries, antenna equipment, and all containers necessary for transportation by truck or pack horse. The instruments received voice messages from a central sending station, but replies had to be by telegraphic code. Equipment for the central sending and receiving station was lent by an interested manufacturer.

The results obtained were very gratifying. At the same time they amply demonstrated the wisdom of carefully studying the needs and conditions before investing in equipment for so specialized a use. Despite difficulties on account of static, interference from a small power plant near the central station, and the unsuitability of the borrowed central-station equipment, message transmission from the

portable sets was 95 per cent reliable over distances up to 40 miles, and across the roughest topography. This degree of success in transmitting code messages from instruments operated by summer employees with only hasty and incomplete training was particularly impressive. Doubts had been expressed of the practicability of such transmission by temporary employees inexperienced both in the handling of radio equipment and in the use of telegraphic code. The doubts were unwarranted. Code transmission is not equal to voice transmission by telephone or radio, but the messages were sent with satisfactory speed and accuracy. Portable radio equipment which will send as well as receive voice is highly desirable, of course, but it is not essential.

Tests are being continued to find out whether an ultralightweight transmitting and receiving set can be developed. The present instrument serves only where truck or pack-horse transportation is practicable, as at trail and fire camps. If a set can be devised light enough for a man traveling on foot to carry in addition to food, water, and tools, it will enable a smoke chaser upon reaching a fire to call back for whatever reinforcements may be necessary. This would prevent the escape of many fires. It is also possible that a set which will transmit as well as receive voice, of about the same weight as the set already developed, can be devised. This possibility will be followed up.

The importance of radio in forest protection should not be overestimated. Radio can not compete with telephone lines for most of the communication service needed. Very few telephone lines already constructed or awaiting construction will be replaced by radio. The function of radio is to maintain communication with camps or men who for one reason or another can not be hooked up with the existing protection telephone system. Its cost may also severely limit its use. The study given the subject exemplifies, however, the established policy of watching for every development, in any field, which promises to contribute to forest protection, of investigating leads that look promising, and of creating a balanced and integrated system of protection of the highest possible efficiency from the combined standpoint of low costs of protection and minimum losses from fires.

PROTECTION FROM TREE DISEASES AND INSECTS

In the summer of 1930 a beginning was made on the eradication of wild currants from the 1,500,000 acres of white-pine producing lands within the national forests of northern Idaho, western Montana, and extreme northeastern Washington. The work was closely coordinated with similar work on near-by private lands. Funds were available only for small-scale operations. It was shortly discovered, however, that the white-pine blister rust was spreading much more rapidly than had been expected.

The economic life of this region is very largely based on its forest industries, and these industries in turn are dependent chiefly on western white pine. The regional production of white-pine products averages from \$35,000,000 to \$40,000,000. About 60 per cent of this is distributed in pay rolls. The elimination of white pine by the

blister rust would mean economic disaster to a territory as large as Maine, New Hampshire, and Vermont.

The disease attacks trees of all sizes but kills small trees faster than large ones. Both the present virgin timber and future supplies will be destroyed unless the wild currants and gooseberries, the alternate hosts of the rust, are speedily and systematically eliminated within infecting distance of the pines—900 to 1,500 feet.

After the unexpectedly rapid spread of the disease became known, plans were made for coordinated and cooperative work by the Federal Government, the State of Idaho, and the private owners, with a view to covering the area needing protection in 10 years, instead of in 20 as was previously contemplated. For the season of 1931 the work on national forests was expanded, with funds made available by a deficiency appropriation, to the extent for which trained and competent personnel were available. Further expansion of the work is essential if the national forests of the region are to accomplish the purposes for which they were set aside, and are to furnish a continuous supply of usable wood for the local manufacturing industries and their dependent communities. The currants and gooseberries should be eradicated from at least 200,000 acres of the Government white-pine land each year (allowing for lands which will have to be cleaned a second time) under the economical and effective methods developed by the research work of the Bureau of Plant Industry.

The disease has not yet reached the important sugar-pine-producing portions of California, but it is known that this tree, like the other American 5-needled pines, is susceptible.

Direct control of insects on the national forests is required chiefly for the protection of grown timber. The bark beetles, which cause the greatest losses, normally attack trees of merchantable size. The protection of present values, either in the form of loggable stands or in the form of scenic attractiveness, rather than provision for the growing of future crops, is usually the aim. Tree-killing insects rarely destroy the productive power of a forest directly, though they are often an important factor in the creation of barren areas, because the masses of dead trees which are the aftermath of a severe insect infestation constitute a serious fire danger for many years.

The control of bark-beetle epidemics on the national forests was centered on the areas where the largest values were imperiled. The epidemic in the western white pine on the Coeur d'Alene National Forest, in Idaho, broken on some of the areas by the work done in the spring of 1930, had to be further fought to prevent reinfestation from missed broods and from territory not reached previously. A small amount of similar "mop-up" work was done in western white pine on the near-by Clearwater Forest and more on the Kootenai Forest, in northern Montana. The largest project, however, was in the lodgepole pine on the national forests near or adjacent to Yellowstone National Park, coordinated with work within the park boundaries by the National Park Service.

New centers of infestation were found on or near the Madison National Forest in Montana, the Targhee Forest in Idaho, and the Teton and Wyoming Forests in Wyoming. Both fall and spring work was done, in spite of difficulties due to mud and high water in the spring and to snow in both seasons. Pack-animal transporta-

tion, with the fording of mountain streams during spring freshets, was necessary in some cases, as on the Grays River project in Wyoming, where centers of infestation were scattered along 45 miles of a mountain-bordered, roadless valley. The work was of material aid in relieving bad local unemployment conditions. Heads of families were given preference.

The organization and effective supervision of a large insect-control job puts a strain on the regular local administrative force comparable only to that caused by a bad fire season. The employment, transportation into remote areas, sheltering, and supporting of hundreds of laborers takes precedence over other work and necessitates its postponement to meet the emergency. Insect epidemics occur irregularly on any one forest or in any one region, and no permanent organization for handling them is feasible. Insect-control projects are emergency protective jobs, often to be done under difficult climatic and transportation conditions.

Relatively small control projects were undertaken in Oregon and in California against another species of bark beetle, which attacks chiefly western yellow pine. One of these projects was in cooperation with the National Park Service to eliminate an infestation partly within the Yosemite National Park and partly on the adjoining national forests. On another, in Oregon, the active cooperation of the owner of adjacent private lands was obtained. An area adjacent to the Crater Lake National Park was cleaned of infested lodgepole pine as part of a cooperative project involving chiefly park lands.

Most effective cooperation was maintained with the Bureau of Entomology throughout the year. The advice of the experts of that bureau was freely sought and cordially given. This advice and assistance was of direct and material help in obtaining effective and economical results.

Examinations showed that the work done on the Colorado National Forest, mentioned in last year's report, had been successful and that no additional effort was necessary in 1931. On the Nebraska National Forest the parasites introduced by the Bureau of Entomology continued to reduce the tip-moth damage to the plantations. At the close of the year there were strong indications that a serious bark-beetle epidemic was building up in the western yellow-pine stands in California. The attacking species has two generations each season, so that the degree of infestation in different places can not be determined until late in the fall. Arrangements have been made for collecting the necessary information in cooperation with the Bureau of Entomology.

TIMBER

The business depression was reflected in a reduction in the cut under national-forest timber sales from 1,488,096,000 board feet in the previous year to 1,052,616,000 board feet—about the same amount as was cut in 1925. The reduction was greater where, as on the Pacific coast, most of the manufactured product goes into the general market than where most of it is used locally, as for example in the central Rocky Mountain region; but some decrease occurred in all

regions except in the Lake States, and the increase there was insignificant.

The falling off in the cut of national-forest timber under sales appears to have been about proportional to the lessening of activity in the lumber industry of the country as a whole. Additional timber, amounting to 171,455,000 board feet, approximately the same as in the previous year, was cut under land-exchange agreements. As has been pointed out in previous reports, the cutting of timber under exchanges represents essentially not the marketing by the Government of public stumpage but the liquidation of private stumpage and a shift in the location of the national-forest holdings, since in the course of a year the standing timber on the lands transferred to public ownership at least equals the amount made over to the private owners.

The reduction in receipts from timber sales was more, proportionately, than the lessening in cut. This was due partly to the shutting down of operations or to very small-scale operations by holders of long-term contracts for relatively high-priced timber, and partly to a decrease in advance payments. Some companies continued to cut until they had taken all the timber covered by their advance deposits, and then shut down. Others continued to operate, but on a reduced scale, making advance payments in smaller amounts than in previous years, so that the sums to their credit at the close of the year were smaller than at the beginning. In consequence the value of timber delivered during the year exceeded by \$383,512 the receipts from sales. The advance deposits on hand at the end of the year were cut down in equal amount.

Near the close of the year the long-standing policy of not offering large sales of timber for new sawmills was reaffirmed and extended by direction of the President. This policy was first inaugurated because the productive capacity of the already-existing sawmills has been steadily in excess of the needs of the country for lumber, leading to overproduction. It is recast with more rigid definition as an assurance to the lumber industry that during the period of depression, which has greatly augmented the very serious difficulties of the industry, national-forest timber will not be sold to supply needs that private stumpage is available for. Public announcement of the reaffirmed policy was made as follows:

No sales of national-forest timber will be made during the present economic situation where the value of the timber is in excess of \$500, except under the following three enumerated conditions:

- (1) To supply the needs of already-existing sawmills which are dependent upon the national forests for their raw material and where such raw material can not be obtained elsewhere.

- (2) To furnish domestic paper mills with raw material needed to supply the domestic market with newsprint and other wood-pulp products.

- (3) To dispose of wind-thrown, fire-damaged or fire-killed, and insect-infested timber.

This policy protects the users or manufacturers who are dependent upon a stable supply of timber from the national forests, but removes any possibility of the crowding of lumber from new enterprises supported by national-forest stumpage, on a market already fully supplied. The exception in regard to sales of pulpwood is due to

the importation, as pulpwood, wood pulp, or paper, of over half of the pulp products consumed in the country. The use of American wood in American mills for the manufacture of a larger proportion of the country's newsprint and other papers would employ American labor and would utilize American natural resources. It is not expected that large sales to salvage dead or damaged timber, under the third exception, will be necessary.

The awards of the large sales of pulpwood in Colorado, mentioned in last year's report, were allowed to lapse by the highest bidder, in view of the general business conditions. The availability of spruce and true fir in the Rocky Mountains, as well as of hemlock and spruce in Alaska, is now well known, however, and will inevitably lead to the utilization of these national-forest pulpwood resources.

Conditions in the lumber industry led to the adoption of a liberal policy of extensions of contracts and of reducing the amounts required to be cut during specific periods. For example, one company which has contracts for timber to supply three separate mills wished to operate only two, and was given an extension of the time within which the contract required that timber intended for the third mill must be cut in a specified amount. Thus holders of contracts were under no pressure to add to the existing supply of lumber by continuing operations merely in order to meet the time requirements of their agreements.

The national-forest timber-sale business for the calendar year 1930 is summarized in Tables 9, 10, and 11.

TABLE 9.—*Number of national-forest timber sales, classified according to amounts of sale, by States, calendar year 1930*

State	\$500 or under, commercial sales	\$500 or under, cost sales	Total	\$501 to \$1,000	\$1,001 to \$5,000	Over \$5,000	Total
Alabama	1		1				1
Alaska	196		196	6	7	2	211
Arizona	1,208	190	1,398	4			1,402
Arkansas	67	54	121	1		2	124
California	563	245	808	2	11	12	833
Colorado	787	261	1,048	5	14	5	1,072
Florida	152		152		2	1	155
Idaho	939	1,365	2,304	8	18	9	2,339
Michigan	42		42				42
Minnesota	223		223	1	2	3	229
Montana	683	1,156	1,839	7	7	4	1,857
Nebraska	40		40				40
Nevada	68	113	181				181
New Hampshire	197		197	2	5		204
New Mexico	1,195	621	1,816	2	3	2	1,823
North Carolina	328		328		6	3	337
Oklahoma	19		19				19
Oregon	684	488	1,172	4	5	8	1,189
Pennsylvania	8		8	1			9
South Dakota	448	74	522		7	4	533
Tennessee	293	3	296	6	5	2	309
Utah	320	534	854	1	1		856
Virginia	357		357	1	2	1	361
Washington	274	77	351	4	6	13	374
West Virginia	24		24		1		25
Wyoming	335	229	564	2	1	1	568
Total, 1930	9,451	5,410	14,861	57	103	72	15,093
Total, 1929	8,330	5,230	13,560	75	122	107	13,864

TABLE 10.—Quantity and value of national-forest timber sold, calendar year 1930

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alabama.....	10,000		10,000	45		45
Alaska.....	40,870,000		40,870,000	70,647		70,647
Arizona.....	8,705,000	295,000	9,000,000	17,937	311	18,248
Arkansas.....	7,236,000	188,000	7,424,000	39,835	192	40,027
California.....	114,802,000	1,345,000	116,147,000	304,781	1,058	305,839
Colorado.....	255,587,000	872,000	256,459,000	531,777	945	532,722
Florida.....	6,260,000		6,270,000	44,052		44,052
Idaho.....	157,735,000	4,046,000	161,781,000	516,541	3,673	520,214
Michigan.....	1,551,000		1,551,000	3,111		3,111
Minnesota.....	263,896,000		263,896,000	550,553		550,553
Montana.....	28,243,000	4,480,000	32,723,000	85,826	4,667	90,493
Nebraska.....	58,000		58,000	180		180
Nevada.....	1,871,000	296,000	2,167,000	1,631	261	1,892
New Hampshire.....	4,817,000		4,817,000	19,329		19,329
New Mexico.....	231,470,000	924,000	232,394,000	455,716	1,005	456,721
North Carolina.....	23,456,000		23,456,000	52,271		52,271
Oklahoma.....	167,000		167,000	251		251
Oregon.....	126,983,000	2,272,000	129,255,000	349,423	1,576	350,999
Pennsylvania.....	1,027,000		1,027,000	1,800		1,800
South Dakota.....	23,127,000	204,000	23,331,000	71,689	263	71,952
Tennessee.....	17,723,000	5,000	17,728,000	31,058	6	31,064
Utah.....	7,102,000	1,071,000	8,173,000	13,044	1,134	14,178
Virginia.....	26,840,000		26,840,000	37,064		37,064
Washington.....	1,990,210,000	251,000	1,990,461,000	6,528,528	173	6,528,701
West Virginia.....	555,000		555,000	1,791		1,791
Wyoming.....	12,994,000	873,000	13,867,000	31,719	758	32,477
Total, 1930.....	3,353,295,000	17,122,000	3,370,417,000	9,760,599	16,022	9,776,621
Total, 1929.....	1,032,068,000	18,826,000	1,050,894,000	3,298,527	17,283	3,315,810

¹ In addition, minor products not convertible into board feet were sold, value \$41,704.

² In addition, minor products not convertible into board feet were sold, value \$50,010.

TABLE 11.—Quantity and value of national-forest timber cut under sales, calendar year 1930

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alabama.....	16,000		16,000	66		66
Alaska.....	44,957,000		44,957,000	80,685		80,685
Arizona.....	50,206,000	270,000	50,476,000	115,873	292	116,165
Arkansas.....	24,850,000	194,000	25,044,000	164,815	199	165,014
California.....	318,714,000	1,291,000	320,005,000	975,673	976	976,649
Colorado.....	53,778,000	825,000	54,603,000	130,878	927	131,805
Florida.....	3,848,000		3,848,000	13,607		13,607
Idaho.....	100,726,000	4,141,000	104,867,000	415,919	3,846	419,765
Michigan.....	1,847,000		1,847,000	3,880		3,880
Minnesota.....	13,640,000		13,640,000	45,276		45,276
Montana.....	33,178,000	5,129,000	38,307,000	99,239	5,433	104,672
Nebraska.....	53,000		53,000	177		177
Nevada.....	997,000	269,000	1,266,000	1,545	242	1,787
New Hampshire.....	15,869,000		15,869,000	101,904		101,964
New Mexico.....	14,786,000	907,000	15,693,000	31,459	920	32,379
North Carolina.....	14,017,000		14,017,000	39,347		39,347
Oklahoma.....	167,000		167,000	251		251
Oregon.....	196,209,000	2,464,000	198,673,000	495,527	1,721	497,248
Pennsylvania.....	4,023,000		4,023,000	13,418		13,418
South Dakota.....	41,284,000	224,000	41,508,000	159,602	295	159,897
Tennessee.....	6,435,000	32,000	6,467,000	14,682	32	14,714
Utah.....	12,323,000	969,000	13,292,000	27,107	1,009	28,116
Virginia.....	15,159,000		15,159,000	41,186		41,186
Washington.....	212,765,000	168,000	212,933,000	471,760	119	471,879
West Virginia.....	509,000		509,000	1,766		1,766
Wyoming.....	56,780,000	944,000	57,724,000	153,337	948	154,285
Total, 1930.....	1,237,136,000	17,827,000	1,254,963,000	3,599,039	16,959	3,615,998
Total, 1929.....	1,402,275,000	18,913,000	1,421,188,000	4,086,086	16,933	4,103,019

¹ In addition, other products not convertible into board feet were cut, value \$22,142.

² In addition, other products not convertible into board feet were cut, value \$18,134.

PLANTING

The development of planting on the national forests east of the Great Plains was continued. A new large nursery was started near Rhinelander, Wis., on land donated for the purpose. This nursery will supply trees for reforesting areas denuded by past fires and cutting on the lands being purchased for national-forest purposes in Wisconsin and in the near-by portion of Michigan. The nursery at Russellville, Ark., was enlarged to produce 1,000,000 seedlings annually, for use chiefly in reforesting abandoned fields in the Ozark National Forest. These nursery developments were authorized by the Knutson-Vandenberg Act of June 9, 1930, with the expectation that the fiscal program for national-forest planting will be carried out by appropriations in subsequent fiscal years as authorized by that act. This program will bring the planting activity into balance with other activities on the eastern national forests, but not on the western. Purchases by the National Forest Reservation Commission are constantly adding to the area of eastern national-forest land needing to be planted. The strategic location and potential productivity of the eastern forests make it wise to increase operations in that part of the country as additional funds become available under the present limited fiscal program, and to defer the enlargement of operations in the West, although many large old burns, some of them antedating the setting aside of the forests from the public domain, must remain unproductive until their artificial reforestation can be provided for.

Planting requires planning years ahead. First the area which it is proposed to plant is examined to determine what portion of it, if any, may be expected to become timbered by natural seeding, and the exact area which must be planted if it is to have a timber crop restored. The species and sizes of trees best suited to the particular sites are determined, and the work of planting is mapped out by seasons or years, with due regard for transportation facilities, suitable camp sites, and other matters on which depend the economy and efficiency of the work. The planting is then assigned to definite years in the future. There follows the collection of tree seeds of the right species and varieties, in the quantities necessary to produce, in the nursery, the number of young trees needed. From two to four seasons are required to grow the trees in the nursery to the right size and condition for planting on the specific sites to which they were allocated. Thus each year the actual setting out of the young trees is the culmination of several years of carefully planned work. In many cases over half of the cost is incurred in collecting seed and growing the trees in a nursery, in years previous to the actual planting. No sudden expansion of the acreage planted is ordinarily possible. Only when and to the extent that suitable nursery stock can be purchased from State or private nurseries having surpluses can planting on national forests be expanded to meet temporary emergency conditions such as widespread unemployment.

Planting is done in the spring as soon as the melting of the snows permits, or in the fall after the first heavy rains, but before snow covers the ground. The opportunities for temporary jobs in planting crews are welcomed by many farmers, who thus prolong the season of work. Frequently owners of small farms or ranches return year after year to work for a month or six weeks in the planting camps

on some national forest, and have come to count on the wages so earned as an essential part of their income. These selected, experienced men need less training and supervision than do those unfamiliar with the conditions and methods. Many are heads of families, and the extension of their working season, especially in the spring of 1931, was welcomed as a means of family support.

This was especially true within the region which suffered from the 1930 drought. The national forests in West Virginia, Arkansas, Michigan, and Nebraska were within the drought area, and in employing planting labor, care was used to give as effective relief as possible.

Within the drought region recent plantations on some forests suffered severe losses. This was particularly true of the national forests in Nebraska and Michigan. In other places, as in West Virginia, local showers in the mountains were sufficient to keep the trees alive over the drought period. On the Bessey division of the Nebraska National Forest and on the Huron Forest in Michigan considerable areas planted in the spring of 1930 had to be replanted in the spring of 1931 or still remain to be replanted.

In the fall of 1930 trees suitable for planting were produced for the first time from the nursery at Susanville, Calif., and from the area added to the nursery at East Tawas, Mich. This new production was made possible by the act of March 26, 1929, which authorized the purchase of the sites. The enlarged supply permitted an increase in the total acreage planted from 18,196 acres in the calendar year 1929, to 21,702 acres in 1930, with an additional 5,037 acres partially replanted. Increased output from the additions to the nurseries at Monument, Colo., and Halsey, Nebr., made under the same legislative authorization, will begin in 1932 or 1933.

During the year the accumulated experience of 20 years of nursery work was made available to the public by the publication of a circular, *Growing Trees for Forest Planting in Montana and Idaho*. It contains descriptions of the machines and methods developed at the Savanac nursery in Montana. The adaptation of these devices to diverse conditions will help to decrease the cost of national-forest planting in all regions, and of planting-stock production by other agencies.

The areas planted and sown in the calendar year 1930 are shown, by States, in Table 12.

TABLE 12.—*Planting and sowing on national forests, by States, calendar year 1930*

State	Area planted	Area sown	Total	State	Area planted	Area sown	Total
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>		<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Michigan.....	8,452.50	-----	8,452.50	Wyoming.....	214.30	-----	214.30
Idaho.....	4,166.96	-----	4,166.96	Florida.....	165.10	-----	165.10
Wisconsin.....	1,500.00	-----	1,500.00	Arkansas.....	73.00	-----	73.00
Colorado.....	1,486.49	-----	1,486.49	New Hampshire.....	67.40	-----	67.40
Nebraska.....	1,173.01	-----	1,173.01	Tennessee.....	62.50	-----	62.50
Washington.....	924.00	-----	924.00	Virginia.....	38.20	-----	38.20
Minnesota.....	856.70	-----	856.70	Utah.....	19.75	-----	19.75
Montana.....	790.00	-----	790.00	Nevada.....	4.00	-----	4.00
Pennsylvania.....	548.00	-----	548.00	Oklahoma.....	3.00	-----	3.00
Oregon.....	535.00	-----	535.00	North Carolina.....	1.50	-----	1.50
West Virginia.....	312.70	-----	312.70				
California.....	307.91	12.00	319.91	Total.....	21,702.02	12.00	21,714.02

¹ In addition 5,037.5 acres in Michigan and Minnesota were partially replanted.

RANGE

Throughout the western range States the spring of 1930 was unusually dry. Forage failed to make its normal growth, and unusual damage to the range might have occurred had not some feed been left on the ground from the previous year. This tided the situation over until, in late July and August, rains fell pretty generally in all regions. The forage then made a rapid growth, and while the production was below normal, stock came off the national-forest ranges in fair condition.

As usual in drought periods, outside ranges were more seriously affected than those within the national forests. The most critical situation arose in Montana, where urgent demands were made for increased grazing privileges on the national forests. At the risk of a temporary overstocking, relief was provided for 151 cattle and horse raisers and 64 sheep owners whose outside ranges had failed, through increases that allowed 5,691 cattle and horses to graze for two and one-tenth months and 78,413 sheep for three-quarters of a month.

The ability of national-forest ranges to withstand long periods of drought better than ranges not under regulation does not justify an expectation that it can regularly meet the increased demand created by a shortage of forage on private or uncontrolled range. To the extent that range conservation permits, the Forest Service stands ready, and desires, to assist in times of emergency; but a permanent solution of the problem must be accomplished in a different way. The principles of conservative use practiced on national forests are equally applicable to outside ranges. Stockmen would do well to safeguard themselves against emergencies due to feed shortage by seeing to it that some forage is always left on private ranges at the close of the season. This can be done by limiting operations to the number of stock that can be carried during subnormal seasons and by adopting other well-tried, improved practices.

As a rule, the deficiency of precipitation in 1930 followed and was made more serious by several years of previous shortages. The desirability of a further adjustment in range capacities has now become fully manifest.

Considering the general business situation, market prices on cattle held up exceptionally well throughout 1930, but market values of sheep continued to decline. There is strong evidence that retrenchment in operating expenses has materially affected the management of sheep on the national forests. Reductions in wages naturally tend to result in a lower quality of services. It is appreciated that periods of depression force operators to drastic economies, and whatever loss of efficiency in range management last year was due to that may be charged up as a public contribution to the efforts of stockmen to make income and expenditures balance.

The necessity of reducing operating expenses also brought about an urgent demand for a reduction in grazing fees. With a full appreciation of the unfavorable market conditions and the laudable efforts of stockmen to make their business pay, the Forest Service believes that the maintenance of a permanent policy with regard to the amount of the fees and the manner in which they are to be paid is of far greater importance to the industry than any temporary

benefits which might accrue through their reduction or through a departure from the prescribed method of payment. The Forest Service is committed to a fair and reasonable fee, fixed in amount for a rather long period. It was and is appreciated that fluctuations in the market prices of livestock products will occur in the future, as they have occurred in the past. Approval of the request of stockmen at this time would, in the interest of consistency, dictate an increase in fee under favorable conditions. This would lead to end-
less controversy. The fee now being charged is below the price paid for comparable range by those not privileged to graze on the national forests. It is fully expected that this comparison will hold true for the rest of the 10-year permit period, which expires in 1934. Stockmen have had the advantage of a low fee during years of favorable market conditions and the advantage also of an assurance that during the life of the 10-year permits the charge would be uniform. Presumably, favorable conditions will be restored in the industry in no very long time. It is believed that the present policy is not unfair, but will lend greater stability to the business generally and to the business of those benefiting from national-forest range administration and use in particular.

Table 13 shows the grazing use made of the national forests in the calendar year 1930.

TABLE 13.—*Grazing permits issued and numbers of stock grazed under pay permit on the national forests, by States, calendar year 1930*

State	Cattle, horses, and swine			Sheep and goats	
	Permits issued	Stock grazed		Permits issued	Stock grazed
		Cattle and horses	Swine		
Alabama.....	2	10			
Arizona.....	1,036	172,315	272	123	324,222
Arkansas.....	28	394			
California.....	1,882	148,300	179	366	409,618
Colorado.....	2,807	272,209		923	1,035,225
Florida.....	6	443		3	1,483
Idaho.....	2,644	119,981		1,027	1,295,970
Montana.....	2,132	131,554		472	609,995
Nebraska.....	31	11,315			
Nevada.....	373	51,023		143	318,318
New Hampshire.....	19	136			
New Mexico.....	1,936	82,633	84	283	239,107
North Carolina.....	38	263		3	34
Oklahoma.....	46	2,439			
Oregon.....	1,086	85,489		514	667,708
South Dakota.....	688	27,510		44	32,617
Tennessee.....	22	290		2	70
Utah.....	3,891	110,261	5	2,062	776,656
Virginia.....	70	701		15	428
Washington.....	397	13,493		163	179,044
West Virginia.....	27	210		36	943
Wyoming.....	738	107,734		305	655,622
Total, 1930.....	19,969	1,338,703	540	6,484	6,546,460
Total, 1929.....	19,873	1,370,636	853	6,574	6,666,206

In consequence of a change in form of the statistical records of grazing, Table 13 combines cattle with horses and does not separate the sheep from the goats. During 1930 there were 31,933 fewer cattle and horses and 119,746 fewer sheep and goats grazing under

pay permit than in the previous year. Had all the stock authorized under pay permit (1,356,656 cattle and horses and 6,773,476 sheep and goats) been actually grazed, the forests would have supported the equivalent of 7,474 cattle more than were grazed in 1929. The difference between the number under permit and the number actually grazed is almost entirely governed by business conditions.

Numbers of stock alone are misleading. In terms of cow-months of actual use, for example, the forests carried under pay permit in 1930 the equivalent of more than 100,000 cow-months in excess of the number in 1929. Cattle used the ranges twenty-five one-hundredths of a month longer and sheep eight one-hundredths of a month longer.

The number of term permits issued and the numbers of stock grazed under them remained about the same as in 1929.

Under the policy explained in the report for 1929 with respect to nonuse, range was held for more than 89,000 cattle and horses and more than 239,000 sheep and goats.

RANGE IMPROVEMENTS

The construction of range improvements under a definite program is having a beneficial effect on the range and related resources. Some of the more difficult situations have been remedied, and others are on the way to satisfactory correction, in consequence of the availability of funds to build projects necessary to adequate control of the livestock. Furthermore, the Government is redeeming its responsibility as a good landlord. During 1930, with the Federal funds made available and cooperative contributions, improvements were completed as indicated in Table 14.

TABLE 14.—*Range improvements constructed on national forests, calendar year 1930*

Region	Fences		Corrals		Driveways		Stock bridges		Water develop- ments		Total cost
	Miles	Cost	Num- ber	Cost	Miles	Cost	Num- ber	Cost	Num- ber	Cost	
1.....	48	\$16,254	2	\$259	13	\$1,169	1	\$ 436	103	\$8,206	\$26,324
2.....	68	16,063	2	500	51	2,600	7	4,742	93	6,275	30,180
3.....	475	106,036	12	626					26	34,760	141,422
4.....	58	20,885	2	719	28	992	4	672	261	40,488	63,756
5.....	34	9,830	1	160	9	717			63	10,780	21,487
6.....	56	9,910	6	343	94	1,059	1	520	155	10,057	21,889
Total.....	739	178,978	25	2,607	195	6,537	13	6,370	701	110,566	305,058

GRAZING TRESPASS AND LIVESTOCK LOSSES

Some progress was made in eliminating wild and worthless horses from the range. It was accomplished through the application of orders issued by the Secretary of Agriculture, closing certain areas for definite periods and authorizing forest officers to dispose of animals found on these areas during the closed periods. The application of the impounding regulation also is proving beneficial. The validity of both of these measures has been upheld by the courts.

More accurate data were secured on livestock losses than in former years. It is believed that this was the main reason for an apparent increase in the 1930 losses shown in Table 15 over the losses in 1929. The totals seems large, but in comparison with the number of stock on the forests they are small—a little more than 1 per cent for cattle, and a little more than 2 per cent for sheep. Considering the period grazed, the losses are no greater than those on private ranges and are much less than those on the open public domain. The data, however, point to a leak in the industry which should be greatly reduced. Continued efforts on the part of both stockmen and forest officers to develop and install plans for a more successful control of these losses is called for.

TABLE 15.—*Livestock losses, calendar year 1930*

CATTLE AND HORSES

Region	Stock lost—									
	From poisonous plants		From predatory animals		Through disease		Through other causes		Total	
	Number	Value	Number	Value	Number	Value	Number	Value	Number	Value
1.....	200	\$13,335	24	\$1,600	174	\$11,600	446	\$29,735	844	\$56,270
2.....	2,269	151,275	71	4,735	1,023	68,205	1,308	87,205	4,671	311,420
3.....	657	43,800	892	59,470	630	42,000	1,929	128,605	4,108	273,875
4.....	1,590	106,000	211	14,065	352	23,460	1,294	86,270	3,447	229,795
5.....	537	35,800	32	2,135	238	15,865	1,265	84,335	2,072	138,135
6.....	161	10,730	27	1,800	157	10,465	551	36,735	896	59,730
Total...	5,414	360,940	1,257	83,805	2,574	171,595	6,793	452,885	16,038	1,069,225

SHEEP AND GOATS

1.....	2,611	\$26,110	6,812	\$68,120	1,108	\$11,080	7,777	\$77,770	18,308	\$183,080
2.....	5,301	53,010	8,728	87,280	2,956	29,560	10,244	102,440	27,229	272,290
3.....	1,154	11,540	2,618	26,180	894	8,940	5,555	5,550	5,221	52,210
4.....	10,789	107,890	30,765	307,650	4,383	43,830	19,147	191,470	65,084	650,840
5.....	1,954	19,540	3,053	30,530	1,654	16,540	2,526	25,260	9,187	91,870
6.....	3,074	30,740	7,693	76,930	2,946	29,460	7,499	74,990	21,212	212,120
Total...	24,883	248,830	59,669	596,690	13,941	139,410	47,748	477,480	146,241	1,462,410

STABILITY OF RANGE USE

The annual report for 1929 contained a discussion of range stability and the effects of improved range management. During 1930 some question was raised as to whether the decline in numbers of livestock was not largely due to the efforts of the Forest Service to increase the number of big-game animals, and to restrictions on livestock in the interest of recreation and better watershed and timber production. On the other hand, some game enthusiasts attempted to show that national-forest ranges were monopolized by the stockmen and that game interests were not being fully protected.

The Forest Service has endeavored to maintain a balanced program which would accord all interests full consideration. The situation is one which demands calm consideration, study, development of all the facts, and the fair and harmonious working out of the problem in cooperation with all those affected. The stockman views with considerable alarm reported increases of the past 5-year period

in big-game animals, and the critical conditions which have been and are developing on certain national forests by reason of an overpopulation of game animals. He sees a danger of gradual curtailment of his valuable privilege, although at the same time he is sympathetic to the needs of wild life and resents the implication that he is responsible for its destruction.

When the facts are fully known it becomes evident that many of the assertions in regard to the damage to game by the presence of livestock are not only exaggerated but unsubstantiated. Much of the alleged damage is due to other causes than livestock, causes often unknown to those who criticize. That game animals do not increase more rapidly in certain localities is often due to inadequate winter range outside the national forests, illegal killing, predatory animals, disease, and parasites. From a broad point of view it is believed there is no occasion for alarm. It is true that big-game animals have increased on national forests. It is equally true that restrictions have been made on the grazing of livestock in the interests of game; but no serious actual reduction in numbers of livestock has been made. Areas have been reserved for game purposes, but these reservations have been made gradually, and their loss to livestock interests has been fully compensated for by improved range conditions and management on the rest of their allotments.

Of the total net area of over 132,000,000 acres of national-forest land in the Western States over 86,000,000 acres, or about 65 per cent, is usable range. Of the usable range over 82,000,000 acres, or about 95 per cent, is actually used by domestic livestock. Game animals occupy over 45,000,000 acres of land considered unusable by domestic stock but constituting excellent game range, over 2,500,000 acres closed to use by domestic stock, and over 2,000,000 acres reserved from grazing for other uses. Thus there are nearly 50,000,000 acres of good game range on which domestic livestock does not graze. In addition much range is occupied by both game and domestic livestock, the capacity of the range being determined by the amount of feed available for each class of animals. On the 288 game refuges within the national forests domestic livestock has been restricted to the equivalent of the carrying capacity of 2,000,000 acres.

It should be understood that the necessary adjustments between livestock and game have extended over a period of 25 years. During this long period of gradual adjustment not more than one-fifth of 1 per cent per year of the usable range has been closed to use by domestic stock for game, and this has been largely offset by the opening of new range and by increases in the carrying capacity of old ranges, under regulated grazing.

There has been a reduction in stock months during the last five years of approximately 5.6 per cent. Of this reduction, 28 per cent was in numbers of stock and 57 per cent through shortening the grazing season to protect the productivity of the range. The remaining 15 per cent of the reduction resulted from forfeitures of privileges and the use of surplus range so secured for further protection purposes. It may be, of course, that in some of these cases reductions were made in the interest of both game and livestock. It is certain that the drought period is chiefly responsible and that outright reductions in the interest of game have been inconsequential.

It should be understood that game was almost exterminated on many areas when the national forests were created. The increase in numbers was most gradual, and for many years was hardly noticeable. Systematic protection and the reduction of predatory animals have created a more favorable environment, so that during recent years pronounced increases have occurred. While these increases have occurred on ranges occupied by both domestic stock and game animals, a large part of the increase is on ranges having no domestic stock and, until comparatively recent years, only a few game animals. There are still areas where a large number of game animals and birds might be produced without interference with domestic livestock.

The Forest Service would not be redeeming its responsibility if it failed to recognize the possibility of making all lands fully productive. This involves the devoting of national-forest lands to their highest use. In the application of this principle adjustments in use must be made. They will be difficult to make if the various interests are indifferent to or unfamiliar with the facts, or are unwilling to recognize that a variety of uses may be secured from the same tract of land. Experience has shown that controversies may be amicably settled by a joint examination and study of individual areas. Studies so conducted have in the past proved conclusively that views may be harmonized, reductions in livestock or in game secured, and a plan formulated which will work in the interest of all concerned. As custodian of Federal property, the Forest Service must prevent damage to the land and resources. This means that decisive action must be taken in cases where the land is being occupied by a number of animals, either domestic livestock or game, or both, in excess of the permanent carrying capacity of the range.

RECREATION AND GAME

The inspirational and recreational values of the national forests grow in popularity with each passing year, particularly as new regions are made accessible by Federal and State highway construction. Since 1916 the number of visitors has increased more than tenfold. Access to the national forests is unrestricted except during brief periods of critical fire danger, and the number of visitors can only be estimated, on the basis of available data and personal observation. While such estimates are necessarily approximations, they correctly reflect the year-to-year changes in this form of use. For the calendar year 1930 the estimated number of visitors was 31,904,452, a slight increase from the preceding year. It included 326,826 special-use permittees and guests, 1,330,610 hotel and resort guests, 1,980,736 campers, 3,272,680 picnickers, and 24,993,600 transient motorists.

Much of this use is by local residents, but a substantial part is by people from remote sections. Motor cars from every State and Territory in the Union are to be found on the national-forest roads and camp grounds. The resulting business is of great importance to local commercial enterprises, so that the recreational potentialities of the national forests now have a substantial significance for their regions.

Without reasonably adequate provision for the maintenance of sanitary conditions and the prevention of fires this enormous influx of people would create serious hazards to public health and property. The establishment of public camp grounds minimizes these hazards. The provision of 156 additional improved camp grounds during the year increased the total to 1,731, but many of them are only partially equipped with the facilities required to bring them up to proper standards of safety and convenience. The total cost of this system of national-forest public camp grounds to December 31, 1930, was \$383,740, of which \$52,601 was contributed by public and private cooperators in cash, materials, and labor.

The greater proportion of visitors use and observe only those national-forest lands which adjoin the highways. In order that the scenic beauties so important to them may be unimpaired, the Forest Service has established the rule that no use of national-forest lands or resources within 200 feet of a class A or class B forest or State highway, or within 100 feet of a class C road, shall be allowed except in conformity with carefully prepared plans or as especially authorized by the regional foresters. This rule meets with general approval and will receive general application.

Table 16 shows more than a million big-game animals on the national forests—a gain of approximately 9 per cent over the number in 1929. The numbers are obtained by estimates of experienced forest officers, and are, therefore, approximations, but they are believed to be as nearly accurate as the nature of the case permits.

TABLE 16.—*Number of big-game animals and beaver on national forests, by States, estimated as of December 31, 1930*

State	Antelope	Bear		Deer	Elk	Moose	Mountain goats	Mountain sheep	Beaver
		Black or brown	Grizzly						
Alabama.....				500					
Alaska.....		5,750	12,800	63,500	14	580	10,300	1,000	425
Arizona.....	4,680	623	9	91,350	2,715			275	5,200
Arkansas.....		2		1,945					
California.....	1,200	8,984		259,298	87			600	70
Colorado.....	102	2,684	17	36,380	10,472			3,450	39,236
Florida.....		122		2,650					
Idaho.....	2,223	5,448	110	64,100	9,305	669	3,350	1,600	13,740
Michigan.....		50		175					6
Minnesota.....		1,455		8,500		2,276			6,020
Montana.....	500	5,496	526	53,560	13,006	1,568	4,196	2,170	16,239
Nebraska.....				96					
Nevada.....	196			7,034				145	162
New Hampshire.....		800		3,000		4			20
New Mexico.....	1,035	925	18	81,250	350			175	1,335
North Carolina.....		181		5,616	38				
Oklahoma.....	1	4		375	350				
Oregon.....	185	6,272		84,520	8,956			60	3,275
Pennsylvania.....		300		5,000	4				100
South Dakota.....	500			5,224	341		3		820
Tennessee.....		18		235					
Utah.....		234	1	54,749	3,105			169	2,866
Virginia.....		550		81	75				
Washington.....		8,336	17	31,002	8,801		4,017	6	11,420
West Virginia.....		300		30					
Wyoming.....	520	1,645	172	17,610	30,595	2,667		2,846	8,323
Total.....	11,142	50,179	3,670	877,780	88,214	7,764	21,866	12,496	109,257

¹ Includes Alaska brown bear.

Leaders in conservation have long recognized that wild life in this country is fast diminishing. The subject has been widely discussed during the past year, and a comprehensive national wild-life policy has been placed before the public by the American Game Protective Association. The situation led to the appointment of a Senate Committee on Wild Life which conducted an inquiry and held extended hearings. Its report to the Senate clearly and forcefully presented the situation. It is believed that the wild-life situation on the national forests is far better than that generally prevailing. Nevertheless, much remains to be done. It is the desire of the Forest Service that the national forests take their proper place in any national program which may be developed.

In order that the Forest Service might have the benefit of the views of competent authorities, a committee composed of representatives of interested organizations was invited to review the work of the Forest Service and the conditions prevailing on the Kaibab National Forest. The committee made the investigation during the period from June 8 to 15, 1931, and submitted a report which will aid greatly in future administration.

WATER POWER

Of the water-power permits and easements issued by the Department of Agriculture, 240 were in force at the close of the year, of which 161 required an annual rental and 79 were free. Of the free permits and easements 57 were for power projects, having an estimated output of 25,897 horsepower, and 22 were for transmission lines, with a length within the forest boundaries of 155.4 miles. The rental permits or easements comprised 55 for power projects, with an estimated output of 514,610 horsepower, and 106 for transmission lines, with a length within the forest boundaries of 887.77 miles.

The new Federal Power Commission authorized the continuance of the past practice under which its field work has been performed through the field organizations of the Departments of Agriculture, War, and Interior. During the year the Forest Service handled a large amount of such work in the form of field engineering and supervision over projects. At the request of the commission the Forest Service also engaged in valuation and accounting work on a number of important projects.

At the close of the fiscal year the regional foresters were supervising the operations of 401 permittees or licenses, an increase of 69. During the year the commission requested field investigations and reports in 46 cases of application for permit or license. The Forest Service reported on 46 cases and also made valuations and appraisals upon 6 cases. Of the 64 projects for which applications were received by the commission during the year, 43 involved the use of national-forest land. The regional foresters issued 11 permits for projects of 40 horsepower and less, for periods not exceeding 10 years.

In a number of cases difficulties have arisen through conflicting uses. To decide which is the more important, a determination must be made of all the values involved. Interferences of dam and reservoir projects with road projects have brought conflicts between the use of land for irrigation and power development and for highway building in the Snake River Canyon and on the Kings River, and

between use for power and use for a road on the Salmon and North Umpqua Rivers and on the South Fork of the Payette River. The forests must have plans which will provide for the utilization of the land for its highest value, and which will also provide where possible for a correlated utilization of other values. A valuation for power is a difficult matter, but steps have been taken which it is believed will lead to a satisfactory outcome.

Some confusion has arisen through power classifications and withdrawals within the national forests made by the Geological Survey without the knowledge of the Forest Service. Arrangements have now been made whereby the Geological Survey will permit a more accurate determination by the Forest Service of what forest lands should be withdrawn or classified. Past withdrawals and classifications will be reviewed and field investigations made wherever deemed necessary. Requests by the Forest Service for additional withdrawals and classifications may follow as a result of completed forest-utilization plans.

In April the commission rescinded the order under which the regional foresters have had authority since 1923 to issue licenses for periods not greater than 10 years, for power projects located entirely within the national forests and of not exceeding 40-horse-power capacity.

ROADS AND TRAILS

Table 17 shows the mileage and the estimated expenditure required to complete the planned system of transportation for the national forests. It includes forest highways, forest-development roads, and trails. Forest highways are of primary importance to States, counties, and local communities; development roads are of primary value for the protection, administration, development, and use of the forests; and trails are of primary use for protection. More intensive study of the transportation needs of the properties has added a considerable mileage of new development roads and trails not included in the system as reported last year.

TABLE 17.—*Classification of mileage in forest road and trail system, and expenditures required to complete the system to a satisfactory standard*

Class	Total	Satisfactory standard	Unsatisfactory standard	Non-existing	Expenditures required to complete
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Dollars</i>
Forest highways.....	16, 532	6, 122	9, 048	1, 362	189, 100, 890
Forest-development roads.....	65, 861	22, 724	16, 638	26, 499	65, 056, 590
Trails.....	155, 597	112, 427	9, 047	34, 123	5, 497, 990
Total.....	237, 990	141, 273	34, 733	61, 984	259, 655, 470

Tables 18 to 20, inclusive, furnish information regarding forest-road appropriations and accomplishments. A large number of what are known as "motorways" and "trailways," providing more simple and inexpensive means of travel than the regular development roads and the regulation trails, were constructed in place of or supplementing the latter. The total mileage of all construction is shown in Table 18.

TABLE 18.—Construction, improvement, and maintenance of roads and trails from forest road appropriations and other Federal and cooperative funds, by States, June 30, 1931

State	Fiscal year 1931				Total to June 30, 1931		Expenditure to June 30, 1931		
	Constructed		Maintained		Constructed		Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails	Roads	Trails			
	Miles	Miles	Miles	Miles	Miles	Miles			
Ala.....	12.6		114.9		63.1		\$138,797.11	\$25,278.16	\$164,075.27
Alaska.....	10.0		230.2	162.0	237.1	439.7	5,362,909.17	352,747.35	5,715,656.52
Ariz.....	327.6	110.5	1,952.7	2,860.0	1,808.6	1,748.5	6,789,010.99	965,223.10	7,754,234.09
Ark.....	171.9	127.5	257.2	518.6	648.4	646.4	1,512,150.31	30,313.14	1,542,463.45
Calif.....	762.4	401.2	9,610.5	18,007.7	3,297.7	3,947.8	16,271,263.49	4,954,451.45	21,225,714.94
Colo.....	79.3	422.4	772.4	11,420.8	1,480.9	5,067.3	7,502,648.56	933,740.41	8,436,388.97
Fla.....	575.8		66.0		824.7		497,652.27	138,661.18	636,313.45
Ga.....	48.3	40.0	157.0	197.2	112.3	252.6	582,054.33	74,943.61	656,997.94
Idaho.....	310.9	2,216.4	2,660.6	19,581.0	2,352.9	14,383.5	15,868,975.78	1,828,846.45	17,697,822.23
Ill.....							427.24		427.24
Kans.....					3.4		2,111.51		2,111.51
Ky.....							808.72		808.72
La.....	77.5				77.5		19,765.00		19,765.00
Me.....		15.2	5.3	45.8	5.3	61.0	49,332.48		49,332.48
Md.....							70.05		70.05
Mich.....	176.5		244.0		260.5		184,718.09	394.93	185,113.02
Minn.....	27.3	40.0	284.8	369.6	390.3	536.7	880,438.43	268,277.07	1,148,715.50
Mont.....	146.4	2,333.8	1,575.3	14,935.2	1,139.2	9,157.0	9,441,382.09	645,885.59	10,087,267.68
Nebr.....			48.8		48.3		103,524.51	990.80	104,515.31
Nev.....	25.8	42.5	320.5	1,514.0	479.9	896.1	1,595,026.08	155,717.16	1,750,743.24
N. H.....	9.7	39.0	43.0	446.0	57.9	485.0	393,234.46	18,474.83	411,709.29
N. J.....							217.71		217.71
N. Mex.....	189.2	66.0	1,595.0	3,109.0	1,040.5	1,558.1	4,703,041.77	328,394.05	5,031,435.82
N. Y.....							81.32		81.32
N. C.....	30.5	27.6	213.2	595.3	200.7	640.6	861,829.06	503,726.57	1,365,555.63
N. Dak.....					1.0		57.75		57.75
Okl.....	3.0		19.1		27.7	16.5	78,822.03	12,362.16	91,184.19
Oreg.....	633.8	895.5	6,176.7	14,161.8	3,659.4	7,388.0	14,724,890.23	6,739,232.86	21,464,123.09
Pa.....	12.0	23.0	124.5		59.2	23.0	173,316.16	21,850.54	195,166.70
Porto Rico.....	2.0			36.3	6.6	36.3	22,521.15	550.00	23,071.15
S. C.....			12.0	10.0	6.3	18.2	111,011.41	15,659.81	126,671.22
S. Dak.....	20.5	5.9	138.0	41.6	307.8	77.6	952,278.58	243,496.11	1,195,774.69
Tenn.....	12.2	45.5	83.8	577.9	105.3	620.4	516,248.88	189,884.30	706,133.18
Utah.....	118.9	169.3	1,063.9	3,095.8	1,185.2	3,617.6	3,943,047.06	905,558.47	4,848,605.53
Va.....	24.6	78.6	74.1	443.2	135.5	871.8	726,719.46	50,856.11	777,575.57
Wash.....	274.0	1,198.4	2,006.3	11,871.0	1,287.1	6,628.5	9,500,518.24	1,644,715.61	11,145,233.85
W. Va.....	39.0	100.0	118.8	339.9	117.0	443.7	347,953.56	5,300.00	353,253.56
Wis.....	65.4				65.4		63,133.43	1,820.00	64,953.43
Wyo.....	51.2	172.2	757.2	4,860.0	1,025.6	2,375.0	4,801,142.27	388,756.52	5,189,898.79
Total.....	4,238.3	8,611.7	30,725.8	109,199.7	22,518.3	61,936.9	108,723,130.74	21,446,108.34	130,169,239.08

TABLE 19.—Distribution among the States of the apportionments for the fiscal year 1932

State	10 per cent fund	Forest high-ways	Forest-road development	Total
Alabama.....	\$54.55	\$7,990.00	\$13,484.00	\$21,528.55
Alaska.....	5,172.55	945,548.00	18,123.00	968,843.55
Arizona.....	27,567.83	593,906.00	155,482.00	776,955.83
Arkansas.....	8,014.28	92,244.00	75,689.00	175,947.28
California.....	112,329.78	1,432,765.00	517,317.00	2,062,411.78
Colorado.....	54,084.80	678,687.00	195,213.00	927,984.80
Florida.....	4,023.90	32,769.00	18,143.00	54,935.90
Georgia.....	868.09	19,385.00	27,827.00	48,080.09
Idaho.....	53,232.45	1,045,437.00	483,866.00	1,582,535.45
Illinois.....		826.00		826.00
Louisiana.....	.65	764.00	5,268.00	6,032.65
Maine.....	321.44	2,889.00	2,223.00	5,433.44
Michigan.....	393.06	17,680.00	30,994.00	49,067.06
Minnesota.....	3,553.45	64,333.00	21,320.00	89,206.45
Montana.....	26,860.79	819,893.00	281,255.00	1,128,008.79
Nebraska.....	842.45	9,821.00	1,624.00	12,287.45
Nevada.....	10,372.28	187,008.00	17,764.00	215,144.28

TABLE 19.—*Distribution among the States of the apportionments for the fiscal year 1932—Continued*

State	10 per cent fund	Forest high-ways	Forest-road development	Total
New Hampshire	4,631.38	45,608.00	18,459.00	68,698.38
New Mexico	12,884.58	415,539.00	101,940.00	530,363.58
North Carolina	1,901.57	28,060.00	35,609.00	65,570.57
Oklahoma	605.91	3,628.00	8,365.00	12,598.91
Oregon	49,023.00	1,344,741.00	405,314.00	1,799,078.00
Pennsylvania	1,333.75	18,553.00	30,448.00	50,334.75
Porto Rico	25.50	1,127.00	2,071.00	3,223.50
South Carolina	254.39	3,376.00	1,834.00	5,464.39
South Dakota	12,839.69	79,984.00	17,591.00	110,414.69
Tennessee	1,206.14	25,724.00	22,447.00	49,377.14
Utah	23,221.89	338,185.00	66,039.00	427,445.89
Virginia	2,341.50	32,371.00	34,663.00	69,375.50
Washington	46,069.60	739,295.00	241,761.00	1,027,125.60
West Virginia	189.53	15,739.00	28,222.00	44,150.53
Wisconsin	.63	6,281.00	15,546.00	21,827.63
Wyoming	32,022.18	449,844.00	104,099.00	585,965.18
Undistributed			1 1,229,200.00	1,229,200.00
Total	496,243.59	9,500,000.00	4,229,200.00	14,225,443.59

¹ Improvement appropriation.TABLE 20.—*Distribution among States of the total apportionments, including the fiscal year 1932*

States	10 per cent fund	Section 8	Federal forest road construction	Forest high-ways	Forest road development	Improve-ment	Grand total
Ala.	\$938.77	\$15,456.04	\$1,922.31	\$46,159.00	\$81,597.00	\$16,800.00	\$162,873.12
Alaska	166,607.33	471,111.29	193,549.95	5,945,184.00	236,634.00		7,013,086.57
Ariz.	633,757.26	680,711.90	501,984.55	3,839,308.00	1,504,814.00	295,613.93	7,456,189.64
Ark.	130,319.74	175,008.19	128,773.38	517,079.00	564,121.00	220,639.38	1,735,940.69
Calif.	1,629,161.45	1,468,307.11	1,206,815.23	9,281,860.00	4,559,524.00	614,890.45	18,760,558.24
Colo.	753,404.83	760,499.26	777,307.26	4,520,550.00	1,758,494.00	46,932.53	8,617,187.88
Fla.	42,509.72	119,528.14	21,534.94	172,119.00	153,735.00	92,218.38	601,645.18
Ga.	12,217.61	52,393.57	134,387.16	114,489.00	199,136.00	110,753.71	623,377.05
Idaho	964,662.38	1,199,108.38	1,367,402.82	6,869,191.00	6,572,284.00	912,371.06	17,885,019.64
Ill.				3,493.00	356.00		3,889.00
Kans.	1,867.27						1,867.27
Ky.	722.72				86.00		808.72
La.	.65			1,029.00	5,268.00	19,500.00	25,797.65
Me.	3,820.13	82.41	3,738.77	18,004.00	26,357.00	1,788.46	53,740.77
Md.	70.05						70.05
Mich.	3,821.83	115.63	3,000.00	60,281.00	95,293.00	94,037.66	256,549.12
Minn.	42,852.12	8,292.73	108,352.03	404,874.00	362,218.00	76,084.39	1,002,673.27
Mont.	598,336.41	756,605.60	731,497.39	5,465,160.00	3,332,903.00	234,355.01	11,118,857.41
Nebr.	19,406.39	18.98		65,918.00	30,371.00	578.27	116,292.64
Nev.	178,252.54	195,210.76	82,265.33	1,291,845.00	150,188.00	19,002.61	1,916,764.24
N. H.	50,851.99	341.66	10,941.30	254,639.00	156,022.00	20,611.54	493,407.49
N. J.	118.99				83.00		201.99
N. M.	352,144.63	430,754.76	509,215.36	2,821,469.00	1,162,920.00	227,686.07	5,504,189.82
N. Y.	4.00				20.00		24.00
N. C.	37,715.34	84,733.83	176,890.28	180,439.00	321,537.00	123,322.28	924,637.73
N. D.	45.75	7.00					52.75
Okl.	10,422.38	65.49	2,775.17	29,428.00	33,588.00	14,257.56	90,536.60
Oreg.	1,035,027.95	1,432,791.37	1,077,552.29	8,205,657.00	4,761,057.00	466,194.69	16,978,280.30
Pa.	4,727.50	24.04	21.42	72,018.00	121,214.00	38,000.00	236,004.96
P. R.	120.10	7.00	3,343.09	8,051.00	15,199.00	1,904.35	28,624.54
S. C.	3,080.94	402.10	48,028.61	19,967.00	47,433.00		118,911.65
S. D.	184,209.61	83,820.89	79,341.53	508,705.00	214,958.00	24,548.87	1,095,583.90
Tenn.	19,770.25	103,433.37	28,092.79	150,049.00	221,446.00	35,421.69	558,213.10
Utah	407,394.34	446,148.17	464,562.35	2,303,544.00	691,513.00	88,523.42	4,401,685.28
Va.	46,081.40	58,390.16	71,902.26	202,595.00	313,056.00	93,508.90	785,533.72
Wash.	660,506.50	940,156.07	712,201.40	4,568,625.00	3,451,376.00	430,451.57	10,763,316.54
W. Va.	5,986.32	12,830.41	5,049.24	76,935.00	178,087.00	123,931.31	402,819.28
Wis.	.63			8,530.00	15,546.00	58,551.41	82,928.04
Wyo.	449,340.58	472,384.91	547,551.79	2,972,806.00	1,161,526.00	46,842.71	5,650,451.99
Undistributed		31,308.78				1,229,200.00	1,260,508.78
Total	8,450,278.40	10,000,000.00	9,000,000.00	61,000,000.00	32,500,000.00	25,778,822.21	126,729,100.61

¹ Includes \$3,000,000 appropriated for first emergency-highways within national forest.² Does not include unexpended balance in annual funds: \$2,993.98 of \$1,500,000 improvement appropriation; \$383.81 of \$3,053,000 first emergency improvement appropriation.

TABLE 21.—*Condition of forest-road funds on June 30, 1931*

Fund	Appropriations	Expenditures	Balance
10 per cent.....	\$7,954,034.81	\$7,559,239.76	\$394,795.05
Section 8.....	10,000,000.00	9,968,691.22	31,308.78
Federal forest-road construction.....	9,000,000.00	9,000,000.00	-----
Forest highways.....	48,555,000.00	45,786,060.57	2,768,939.43
Forest road development.....	29,500,000.00	29,295,282.09	204,717.91
Improvement.....	4,553,000.00	4,549,622.21	3,377.79
Total.....	109,562,034.81	106,158,895.85	3,403,138.96

Under the regular procedure \$12,500,000 was authorized for the fiscal year 1931 for the construction of forest roads and trails. Of this amount \$9,500,000 was provided for forest highways and the remaining \$3,000,000 for development roads and trails. Under the legislation to increase employment, enacted December 20, 1930, an additional \$3,000,000 was appropriated for the construction of forest highways, and the same amount for the construction of development roads and trails. While the \$9,500,000 originally authorized for forest highways could be expended upon any road included in the forest-highway system, the expenditure of the \$3,000,000 forest-highways emergency appropriation was restricted by the law to sections located within the forest boundaries.

Both of the \$3,000,000 appropriations were to be expended or placed under contract before July 1, 1931, under the terms of the act. The forest-development road money was allotted to many small projects, with results that have already been recounted. In spite of the fact that the construction went on in the winter season and consequently under bad-weather conditions, very satisfactory results were obtained.

The forest-highway appropriation under the act of December 20, 1930, is being expended upon major road projects by the Bureau of Public Roads. Since practically all such projects are handled by contract it is necessary in each case to make a location survey and to prepare plans and estimates. Naturally this prevented starting the construction immediately. However, the total amount was under contract by July 1 and will be expended during the present field season.

Because of difficulties encountered in purchasing road equipment and the fact that an unusually large amount of such equipment would have to be obtained before the beginning of the field season, the men in charge of the road work in the several regions were called to Washington in December for a general conference. After discussing the value and use of the various kinds of equipment, decisions were reached on the specifications to be used and the amount of equipment to be ordered. Purchases of road machinery for all the regions were consolidated and handled by the Washington office. This effected a considerable saving.

The meeting also brought about a correlation of construction ideas and methods and better use of machinery during the various steps of construction. Marked advances have been made in the construction methods for minor roads, particularly in the use of machinery for practically all of the work. The machinery used is larger and more powerful than formerly and is better adapted to the special conditions encountered. Equipment intended for other purposes has

been redesigned and remodeled so as to adapt it to use in the character of construction involved for protection roads. All of this has greatly reduced the cost of minor-road construction. Present costs are from 50 to 75 per cent of what they were five years ago.

Last year's annual report recounted at some length the objectives that govern the planning of national-forest transportation systems and described the methods pursued in building up the plans for individual forests. The planning work is being pushed upon a number of the forests in each region, with particular stress upon those where the fire danger is greatest. A number of important questions have arisen which must be decided before the plans can be completely formulated. These questions are being given further careful study, and decisions will be made regarding them during the present year.

MAPS AND SURVEYS

During the year the Forest Service published for administrative use 24 maps of individual national forests on a scale of one-fourth inch to the mile, 14 on a scale of one-half inch to the mile, and 4 on a scale of 1 inch to the mile. An index map of the United States showing the location of the national forests was published, 7 proclamation diagrams were issued in cooperation with the State Department, and more than 50 maps, charts, graphs, and illustrations for reports were lithographed.

The major work of the Washington section of drafting consisted of compiling and tracing 12 forest maps, compiling, tracing, or revising 14 miscellaneous maps, amending 49 maps, tracing overlays for 15 recreation maps, preparing 217 maps for congressional, court, and public committee hearings and other purposes, coloring 95 type maps, charts, and transparencies, preparing 492 graphs, forms, and mechanical and botanical drawings, and executing 1,488 charts, posters, and other miscellaneous drafting projects.

Topographic surveys were made on the Kootenai, Flathead, Clearwater, Shasta, Olympic, Ochoco, Malheur, Whitman, and Umatilla Forests, and drainage surveys were made of large areas within the Powell, Sawtooth, and Weiser Forests. Approximately 600 miles of boundaries were established within the purchase units in the Eastern States.

Two contracts were awarded to airplane companies to obtain mapping data required for the preparation of Forest Service maps. This method of obtaining survey data should prove economical for large-scale maps.

The General Land Office surveyed or resurveyed during the year approximately 1,500,000 acres within the national forests. Of original surveys, 48 were initiated, 71 were worked upon, and 43 were completed. Of resurveys, 19 were initiated, work was done upon 35, and 21 were completed.

Three thousand eight hundred square miles of national-forest land were surveyed by the Geological Survey.

The Washington section of photography made 4,182 lantern slides, 102,550 square feet of Van Dyke prints, photostats, blue and blue-line prints, and solar bromides, 3,529 square feet of wet plate, 2,736 square feet of photographic enlargements, and 72 square feet of transparencies. It developed 7,724 films, printed 87,761 "photoviews," and mounted 21,390 square feet of maps and 3,360 prints.

RESEARCH

The necessity for a coordinated attack upon the country's forest problems was pointed out in the report of two years ago; and last year's report gave some examples of how the development of a system of regional forest and range experiment stations is making it possible to bring together and correlate research in forest and range management, forest products, forest economics, and erosion. During the year the Southwestern Forest and Range Experiment Station, covering Arizona and New Mexico, was formally organized on a regional basis, with headquarters at Tucson, in cooperation with the University of Arizona. This station brings together on an expanded basis the range investigations at the Jornada and Santa Rita Range Reserves, now experimental ranges; the range-management and erosion-stream flow studies on the national forests of the Southwest; and the forest-management studies of the former southwestern forest experiment station. Plans were also consummated, and became effective August 1, 1931, for the reorganization under the Northern Rocky Mountain station of all phases of forest research work in the region, including that in forest management which was already being conducted by the station, the forest-products work previously conducted from the regional administrative office, and the forest-survey and range investigations inaugurated by initial appropriations.

In the Pacific Northwest the office of forest products was transferred from the regional administrative office to the experiment station, and the work of the station in forest economics, including the forest survey, was materially expanded. Range investigations were commenced by the California station. At the Southern station both the survey and the forest-management studies were commenced in the bottom-land hardwoods, thus initiating in a coordinated way research in this important but little-understood forest type.

Eleven regional stations are now formally recognized by congressional appropriation. This nearly completes the skeleton of regional stations, so far as the continental United States is concerned. Stations will also be required in Alaska and the tropical possessions. The work of all the stations will have to be expanded if the urgent regional forest problems are to be taken care of.

One of the greatest needs is better knowledge of the relationships of forest and range cover with erosion and stream flow. These relationships present a vast field of complexities as to which precise knowledge is deplorably inadequate. A comprehensive program of research to determine the effect of various forms of vegetative cover on erosion and stream flow was drawn up. Its major aim is to determine to what extent and under what conditions forest, brush, and range cover affect or control water flow and erosion on large areas, and the relationships between them and soil fertility and moisture, usable water, floods, and silting. The results should furnish a guide to action in various fields by Federal, State, and other agencies. The program will be carried on, when it can be undertaken in more than a minor way, under the regional stations, and in many cases in cooperation with other bureaus and agencies.

The value of the forest experiment stations as regional forest-research centers is increased by the assignment to the stations of members from cooperating bureaus under the provisions of the McSweeney-McNary Forest Research Act. Investigations are carried on in the field of forest entomology by the Bureau of Entomology, in forest pathology by the Bureau of Plant Industry, and in wild-life management by the Bureau of Biological Survey. These investigations are fitted into the regional forest-research programs in such a way as to facilitate an effective, coordinated attack upon outstanding problems. Forest entomologists are now established at the Appalachian, Central States, Northeastern, California, and Pacific Northwest stations; forest pathologists at the Allegheny, Appalachian, Northeastern, and Southern stations; and biologists at the Appalachian, Intermountain, Lake States, Northeastern, and Southwestern stations. The Bureau of Plant Industry maintains a pathological division at the Forest Products Laboratory.

Cooperation with other Federal agencies, with State foresters and departments, and with State agricultural colleges and experiment stations is increasing. A number of reports on joint projects have been published by State agencies. Various local public and private agencies have assisted through the assignment of men to research under Forest Service direction or through furnishing equipment.

An additional experimental forest was added to the eight previously established. This, the Olustee, is part of the Osceola National Forest in northeastern Florida. The major effort on this forest, a branch of the Southern Forest Experiment Station, will be the development of naval-stores research. Most of the forest is longleaf pine, with some slash pine, cypress, and hardwoods. This area affords an unusual opportunity for much-needed investigations relating to the southern pine forest.

Funds made available for research activities under various appropriation items for the fiscal year 1931 are compared with the amounts for 1930 and 1932 in Table 22.

TABLE 22.—*Appropriations for research for 1931 as compared with those for 1930 and 1932*

Class of research	1930, directly appropriated	1931, directly appropriated	1932, directly appropriated
Forest-management investigations.....	\$413,000	\$488,500	\$562,000
Forest-products investigations.....	585,000	635,000	641,300
Range investigations.....	67,000	85,000	130,000
Forest-economic studies.....	25,000	50,000	75,000
Forest survey.....	40,000	125,000	200,000
Forest-taxation study.....	65,000	70,000	70,200
Forest-insurance study.....	10,000	10,000	10,000
Erosion-stream flow studies.....	30,000	30,000	100,000

FOREST-ECONOMIC INVESTIGATIONS

The study of practical measures for speeding up the practice of forestry on private lands and for stopping forest devastation, another major economic project authorized by the McSweeney Act, was commenced. The first phase undertaken was a study of the applicability of the principles of selective logging to the Douglas fir

type. The valuable pioneer work by the University of Washington was supplemented and strengthened by additional time and cost studies for each step in utilization, and is being carried through to final conclusions. The results will be immediately applicable to general problems of logging engineering and in selective logging practice. Preliminary indications are that the scientific application of selective logging is potentially a factor of tremendous importance to economical Douglas fir lumbering, the promotion of sustained yield, and in general the better management of this great forest resource.

Another phase of this project is the study of public-forest policies with respect to privately owned forests and public-forest ownership. An analysis was made of the present scope and tendencies of public control over private forests throughout the world. Public control in the United States has been almost wholly confined to requirements for protection against fire. Other countries, as a rule, have gone considerably farther, particularly with respect to forests that serve to prevent soil erosion or to regulate stream flow, or that serve other public interests. Most of these countries are at the same time gradually extending the area of public forests.

Additional sample counties were studied in the investigation by the Southern station of the financial aspects of private forestry practice. The forest-insurance investigation in the Pacific Northwest was directed particularly toward the determination of accurate rates. Field examinations were made of large burned areas in selected counties, and detailed statistical analyses were made of reports on some 1,500 fires to determine the influence of the variable hazard elements.

The results of a study of land utilization in Knott County, Ky., in cooperation with the Bureau of Agricultural Economics and the University of Kentucky, were analyzed and prepared for publication. These show that the steep upper slopes of the mountains are submarginal for their present agricultural use and are better adapted to timber growing. Although present utilization of timber is only about one-third of the net annual growth, the returns from the farm woodlands form about 18 per cent of the net farm income. The development of local wood-using industries and mineral resources, together with adequate roads, would make the forests a very important factor in the local economy and would facilitate forestry practice by both corporate and individual timber owners.

In the stumpage and log price investigation, reports of 3,236 privately owned stumpage and 2,493 log purchases or sales for the calendar year 1928, obtained through the cooperation of the Bureau of the Census, were compiled and published as a statistical bulletin. Reports of 4,344 stumpage and 5,055 log transactions for 1929 were also compiled and made ready for publication, and work upon the reports for 1930 was begun. Progress was made in systematizing and checking the great mass of reports for earlier years preparatory to the development of stumpage-price trends in the several forest regions, and to studies of the relation of various economic factors upon values.

Cooperation was continued with the Bureau of the Census in the collection of the lumber-production statistics for 1930 in the 12 Western States which produce over 40 per cent of the total national

cut. Editing and tabulation of data were practically completed on the biennial canvass made by the Forest Service of 1930 lumber distribution.

Combined with related data for the Canadian Provinces, secured through the cooperation of the Canadian Bureau of Statistics, these data supply the only complete picture of the movement and consumption of lumber in North America. The comprehensive statistical records of lumber production, and also those showing the production and consumption of pulpwood, wood pulp, and paper, which covered the period prior to 1926, were brought down through 1929.

An extensive revision of the data on forest areas, stands, growth, depletion, and related items, compiled in 1920 as the Capper report, was initiated. It will make available for use by the Forest Service, the Timber Conservation Board, and others, in the interim before the completion of the intensive nation-wide forest survey, the best information that can be expeditiously assembled. Although its method is essentially that of compilation, not of field surveys and primary studies, it is a major project involving a wide correlation of effort and the participation of many research and administrative units.

Through this project, the forest-taxation investigation, price studies, and all applicable projects, as well as through assignments of men for consultation and staff service, the division of forest economics is endeavoring to facilitate the work of the President's Timber Conservation Board. The work of this board and the depression in the lumber industry which gave rise to it have emphasized the fundamental part that economic forces play and must play in bringing about both public and private forest management and in the welfare of forest industries, and the critical need for pressing forward investigations in the relatively new field of forest economics.

In addition to the work of the division of forest economics, much of the research in forest management and forest products has a distinct economic bearing. All measures that tend to reduce the cost and improve the quality of the timber that is grown and to improve the market for wood products through more efficient manufacture and utilization help to make forestry practical and attractive as a business undertaking.

FOREST SURVEY

Substantial progress was made on the nation-wide forest survey, particularly on the phase comprising an inventory of the extent and quality of the remaining timber supplies and the conditions on cut-over and burned forest land. In the Douglas fir region of the Pacific Northwest, the gathering of field data on the inventory phase was brought to about 40 per cent of completion, a working plan for determining the growth and yield of the region was prepared, and the major sources of existing data on forest depletion were located and explored in a preliminary way. A study of the consumption of a large number of so-called minor forest products was begun as part of the regional wood-requirements phase. Excellent cooperation was received from the private timberland owners, individually and through their associations, and from the State foresters and several

other interested State agencies in the form of timber-cruise figures, the loan of personnel, and cash contributions.

For the southern Mississippi Basin hardwood region a detailed working plan for the resource-inventory phase was prepared and tested on a representative area. The data gathered are being analyzed to furnish a basis for a final plan of procedure. It will be necessary to cover this region by the random-sample method on an extensive scale, along the same general lines that similar surveys in Sweden, Finland, and other European countries have followed.

Cooperation was continued with the State land economic survey projects in the Lake States. To obtain timber-volume and growth data needed to apply the findings of the State projects to the forest-survey requirements, more than 600 miles of strips were run. In California cooperation with the State on a forest-cover type map resulted in very satisfactory progress. This map will be an invaluable part of the forest survey.

On the wood-requirements phase the usual statistical data on production were collected in cooperation with the Bureau of the Census, and a special study was begun on the consumption of lumber for planing-mill products and the trends in the use of wood for this purpose. Planing-mill products comprise between 35 and 40 per cent of all lumber used in manufacture, and significant changes in this form of use appear to be taking place. A comprehensive attack on the requirements phase was begun by the assignment of an experienced man to direct the work and by entering upon the preparation of a working plan.

Funds were appropriated for the inauguration of the survey in southern-pine territory and the "inland empire" (northern Idaho, western Montana, and eastern Washington). Urgent requests for the extension of the survey to other forest regions show the universally felt need for the basic economic data the project will supply. Consideration by the President's Timber Conservation Board of the economic problems of the forest industries has pointedly drawn attention to the extreme lack of reliable information on the Nation's forest situation and needs for forest products.

In brief, substantial progress was made in this highly important investigation, so fundamental for sound public and private policies relating to the use of forest lands and to the forest industries, although inability to organize the undertaking on the basis contemplated by the authorization will necessarily delay its rate of advance and time of completion.

FOREST TAXATION

The investigation of the forest-tax problem in North Carolina was completed. This study involved the collection and analysis of detailed data for the State as a whole and for three selected counties. The study of the effects of existing forest-tax legislation in the United States was continued with studies in Alabama, Indiana, Iowa, Louisiana, Maine, Massachusetts, Mississippi, Ohio, and Vermont. These investigations also included an inquiry into the organization and financing of the States and their local jurisdictions.

The survey of European tax conditions affecting forestry was nearly completed. Investigators in Europe gathered such data as

were lacking from material procurable in this country. The tax systems and forest management of Austria, England, Finland, France, Germany, Norway, Sweden, and Switzerland were studied to obtain suggestions applicable to the forest-tax problem of the United States.

Continuing the policy of making available the most important factual information currently gathered, progress reports were issued during the year on Property Taxation in Selected Towns in the Forest Land Regions of Minnesota, Tax Delinquency in the Forest Counties of the Lake States, Tax Delinquency in Selected Counties of Oregon and Washington, Assessment Ratios of Forest Property and Other Real Estate in Wisconsin, and Resources and Public Finances of Michigan in Relation to the Forest Tax Problem.

FOREST MANAGEMENT AND PROTECTION INVESTIGATIONS

Increasingly, owners and managers of forest land—Federal, State, and private—turn to the forest experiment stations for information on such matters as how to insure a prompt restocking with desirable species, what yields can be expected, and how best their forest growth can be protected from fire. As knowledge of a wide variety of forest types and conditions is extended, more definite answers are possible. New work designed to meet critical needs in several of the important forest regions was started. The current forest-management research at the Southern, California, and Appalachian Forest Experiment Stations was enlarged, and silvicultural research, with emphasis on western yellow-pine management, was inaugurated at the Inter-mountain station. The Southern station made a start on the growth and yields of the bottom-land hardwoods, and the California station on the silviculture of the redwoods. The California station more aggressively attacked the forest-fire problem by beginning a new series of studies designed to round out the work, which has already established protection principles of great value. The Southern station began a study of fire in relation to naval-stores practice, and the Appalachian station began a study of the mountain hardwood forests of north Georgia.

Studies of natural reproduction are given major emphasis at nearly every station, since the great bulk of our forest lands will be restocked by natural methods. The Pacific Northwest station has found that Douglas fir seed probably does not live more than a year after it falls, and that seed under ordinary conditions is scattered as far as 1,000 feet from the seed trees. Seedling establishment following cutting depends almost entirely upon the supply of seed and the site conditions. The station recommends, to obtain desirable reproduction, a more adequate seed supply than is ordinarily provided by scattered seed trees. With Douglas fir, in the Pacific Northwest nearly all such trees are lost, chiefly by windthrow. In the western white pine region of Idaho and Montana the loss is much less—about 15 per cent of the seed trees more than 14 inches in diameter and 20 per cent of those smaller. Seed trees in the spruce forests of the Northeast are practically certain to blow over.

As the importance of keeping stands growing thriftily has become generally recognized, owners are giving increasing attention to silvicultural-improvement practices. Experiments to determine best

methods have been under way at a number of the stations. The Southern station has been studying methods for the shortleaf pine region, testing both girdling and poisoning as a means of getting rid of trees worthless because of decay or their manner of growth. Black, red, and black-jack oak were easily killed by girdling alone, post oak and hickory less easily, and elm and black gum with decided difficulty. Poisoning kills the tops more effectively than girdling, but appears to stimulate sprouting. Girdling was determined to be cheaper than felling, but has the disadvantage of adding to the fire hazard by creating snags. In the loblolly region of Virginia, preliminary results showed that injecting poisons into the trees is cheaper than either girdling or felling. In the spruce region, the added growth obtained from released spruce and fir more than paid the cost of the treatment.

The problem of converting poor woods into good forest is common to nearly every region. In the eastern mountain region the Appalachian station found that only half the cut-over hardwood lands are restocking with trees over 3 inches in diameter, and of these 70 or 80 per cent on an average are crooked, unsound, or of the less desirable species. Much fewer than half of the saplings are unshaded and free to grow up; and of those that are free, less than half are of desirable species.

Aspen, which covers some 21,000,000 acres in the Lake States, is much less valuable than the conifers or northern hardwoods which once occupied the site. The Lake States station found that in converting aspen coppice to a more profitable forest, underplantings of white pine and white spruce give 35 to 60 per cent survival during the first three years. Norway pine apparently is unsuited for such underplanting because of its inability to withstand shade. Light measurements in the aspen thickets showed from 10 to 25 per cent light above the underbrush, with still less, of course, in the minor vegetation of ferns, grass, and weeds and on the ground. Most conifers of the region can make moderate growth when they receive 25 per cent light, but need 60 per cent for good growth. With Norway pine a definite correlation appears to exist between height growth and light intensity.

Economic conditions in the Corn Belt region of the Central States have practically forced the farmer to pasture his woodland, and to this is largely due its rather generally unproductive condition. Investigations showed that these woodland pastures are being grazed to at least five times their carrying capacity. In consequence the forest growth is retarded and deformed, and all reproduction less than 12 feet high is eliminated. This, combined with the occasional cutting of mature timber and the death of standing trees, is rapidly converting woodlands on the better agricultural soils into open pastures. In the 5-year period between 1920 and 1925 practically 3,000,000 acres of farm woodlands were eliminated. Over 90 per cent of the farm woods are being grazed more or less continuously.

Slash disposal in the western white-pine region is costly and difficult to accomplish satisfactorily because of the inflammable nature of the forest and the large amount of slash left on logged land. Yet the investigations under way in this region seem to show that slash disposal is necessary for adequate reproduction. Where slash covers more than 10 per cent of the ground fewer than 1,500 seedlings of

western white pine per acre may be expected. This is insufficient to assure a reasonably full-stocked stand at maturity. The high value of western white pine and the complexity of its management problems indicate the need for a thorough investigation of its whole life history. Seed apparently remains dormant in the litter for a year or two after maturity. Under some conditions it germinates, and under others apparently similar it does not. Although seed trees are killed by a very light fire, cones will mature on the tree and produce viable seed; yet this source of seed for restocking burned lands is uncertain and unreliable. Many of the contradictions that are at present unexplainable must be worked out before a satisfactory basis for the management of the western white-pine type can be said to exist.

Naval-stores research was actively pushed. On the small areas leased for the purpose at Starke, Fla., a number of tests were completed. Others will be finished in 1931. Relatively little further work will be done at Starke, which has been the center of the naval-stores investigations for eight years. Additional studies will be inaugurated on the new experimental forest near Lake City. A report summarizing the results of the earlier studies is being prepared.

Tests of gum production from French faces made with the new tool devised by the Southern Forest Experiment Station indicate that during the first year 22 per cent more gum is obtained from French than from American faces of the same width, and during the second year 28 per cent more. As in the case of American faces, with a standard 4-inch French face the yield from large trees is greater than from small. Insufficient data have been obtained as yet to determine the quantities obtainable from trees of different diameters.

Several fire studies were completed. A departmental bulletin on what is known as hour control, based on work done in California, was published. Hour control concerns the length of time that should be prescribed as the outside limit within which all fires on a specific area should be reached with an adequate force, and the measures necessary to make possible the attainment of the standard so set up. Another bulletin had to do with forest fires in Michigan, based on the records from 1918 to 1927, and was published by the Michigan Conservation Commission. The study disclosed that the State has in the neighborhood of 2,500 fires annually, with double that number in bad years. The number of fires is apparently increasing, but better protection has materially decreased the area burned and the size of the average fire. The study showed the need for better fire prevention in the lower half of the State and better fire suppression in the upper. Ninety-five per cent of the fires were due to carelessness, and most of the damage was done by a few large fires each year; of the fires studied 6 per cent covered 73 per cent of the total area burned over, did 68 per cent of the damage, and involved 42 per cent of the suppression costs.

A 5-year record of lightning storms and forest fires in the northern Rocky Mountain region was concluded. An analysis of nearly 15,000 reports made by the lookouts revealed recognizable differences between storm types that usually start fires and those that do not. By observing the duration of rainfall ahead of and following the

lightning, the electric activity of the storm, and the proportion of flashes that strike the earth, lookouts often can classify a storm as relatively safe or generally dangerous many hours before any resulting fires produce smoke enough for discovery. Of these lightning storms, about 34 out of 100 cause fires. Less than 10 per cent are the so-called "dry storms," in which practically no rainfall reaches the ground. Dry storms were no more dangerous than the so-called "wet storms." Observations by the lookouts of the occurrence and path of storms, the accompanying precipitation, and the percentage of lightning which strikes the ground are of direct value to the protective organization.

Another major study of weather and fuel relationships was completed by the Northeastern station, for publication by the New York State College of Forestry at Syracuse. For this region duff moisture was found to be the best criterion of fire danger and is directly correlated with evaporation. Fire does not readily start when the duff moisture is 30 per cent or greater. Whether a fire is started depends also upon the quality and structure of the duff and the character of the igniting agency; the compact duff of spruce and fir needles is less easily set afire by a match than the loose litter formed by pine needles or hardwood leaves, but the reverse is true with such compact fire as locomotive sparks and cigarettes. In hardwood leaves these easily burn through the top layers and are extinguished in the moister layer below.

Although volume tables have been prepared for many of the forest-tree species in the United States, for many others either there are no tables, or the tables are based on old methods of utilization, or are applicable only to old-growth conditions no longer commonly encountered. A considerable portion of the effort of the experiment stations has been directed toward supplying the forest owner with such tables, for calculating the contents of standing trees in the various units of measure used in the forest industries. During the year nearly 50 volume tables were prepared, largely for eastern second-growth species. Obtaining the basic measurements is a time-consuming process.

Additions were made to the series of yield tables for the important forest types and species of the country. One bulletin on Douglas fir yields was published by the department, and another on the northern white pine in the Lake States was published in cooperation with the Wisconsin Agricultural Experiment Station. The study found that white pine in Wisconsin grows at about the same rate as it does in New England. On average sites it will produce 10,500 board feet per acre at 40 years of age, and 36,500 board feet at 60 years. On the best sites yields per acre of 19,000 feet are possible in 40 years, and of 58,500 board feet in 60 years.

Yield studies for pure, even-aged natural stands have now reached a point where the preparation of normal yield tables presents little difficulty. Where mixed stands are concerned the problem is more involved, as the varying proportions of the several species present may materially affect the result. In the Sierra pine region the California station found that the presence of western yellow and sugar pines in the stand tends to increase the yield, while Douglas fir tends to decrease it. White fir and incense cedar are about average in this

respect. Probably the most complex study where mixtures of species are involved is that of the upland oaks, where as many as 15 different forest tree species may be found in a single stand. This study, which has been under way for six years, is now nearing completion.

One of the interesting problems in connection with the growth of trees and stands concerns the change that takes place in the reserve stand following cutting. Trees released from the competition of neighbors accelerate greatly in growth, and there has been considerable discussion as to whether this increased growth does not materially change the form of the tree and therefore render unusable the volume tables prepared on the basis of the old stand. Investigations in 40-year-old cuttings of western yellow pine in the Northwest revealed a general tendency for all such released trees to assume a form similar to the average form in the uncut forest. If this holds true elsewhere, the volume tables prepared for old-growth can be applied successfully to the released trees.

In cooperation with the Georgia Agricultural Experiment Station, the Appalachian Forest Experiment Station issued a preliminary report on the forests of the Georgia highlands. This showed that on the best sites yellow poplar will grow at the annual rate of over 650 board feet per acre. In the old-growth forest, subject as it has been to fire, disease, and improper cutting, a growth rate of less than 90 feet per acre was found. On old fields which have been reclaimed by forest the rate of growth is about 150 board feet an acre a year.

An outstanding contribution to forest mensuration was the publication of Correlation-Alinement Charts in Forest Research. This pointed out that purely graphic methods are inadequate for the solution of many forestry problems. The concepts of the modern science of statistics may be applied to graphs and curves with a large gain in accuracy over the familiar graphic processes. The curvilinear-correlation methods applied to forestry problems by Bruce and Reineke combine graphic and statistical technic. The former contributes flexibility, the latter accuracy. The basic assumptions are so generalized that a very wide range of problems may be solved by the methods which these two members of the research staff have developed; yet the results are rigorously checked and appraised. In consequence many problems previously considered insoluble on account of their complexity or the volume of data involved can be successfully studied.

EROSION-STREAM FLOW INVESTIGATIONS

Few lines of investigative effort bear so directly and largely upon human progress and development as those which relate to the preservation of the soil and the regularity of stream flow. Under the national program for erosion-stream flow investigations, mentioned on page 57, a small amount of work has been started in several regions, which is to be expanded during the coming year.

A departmental bulletin was published on the relation of range management to erosion and run-off, and one on soil erosion was published in cooperation with the University of Wisconsin. The latter pointed out that the soil-erosion situation in southwestern Wisconsin is due to primary soil disturbances which contribute to slight movements of the upper soil or to the concentration of water

in channels. Protection by some form of vegetation is necessary, and the best interests of all would be served if slopes of more than 25 per cent gradient were kept in timber and protected from fire and overgrazing, and if slopes of greater gradient than 15 per cent were plowed only rarely. The local situation is only part of the problem, for the eroded material and flood waters are poured into and down the Mississippi.

The Intermountain Forest and Range Experiment Station aided materially in the study of the torrential floods which devastated farms and other property last year in northern Utah. The director of the station served on the governor's special flood commission and was chairman of the committee on causes and prevention measures. This committee found that scant vegetation on portions of the watersheds was a most important contributing factor to the torrential floods, which carried off an enormous amount of fertile soil from the slopes, tore great gullies in the mountain sides, destroyed homes and other properties, and deposited boulders, rocks, mud, and other debris to a depth of as much as 10 feet on highways and farm and city property. The inability of the scant vegetation to prevent the accumulation of flood waters was particularly evident where the fairly heavy natural cover had been depleted on critical parts of the watershed by overgrazing, by fire, and to a small extent by overcutting of timber. The committee's report concludes:

There is ample evidence on the watersheds of Davis County to show that had the plant cover been approximately equal to its original natural condition, the flooding in that section from the rains of 1930 would have been far less serious, if not prevented.

These studies confirm several of the essential features of the more intensive studies on the relation of herbaceous vegetation to erosion control and summer floods in central Utah which were reported last year.

FOREST-PRODUCTS INVESTIGATIONS

For years to come the United States will probably remain first in the list of wood-using nations. Nevertheless in the last decade wood has been taking a smaller place in our total consumption of material. Meanwhile, haste and waste continue in the cutting of much of our best remaining timber. A present low consumption of forest materials tends to restrict future production.

The broader the demand for forest products the better the prospect for forestry and the stronger the incentive to engage in it. Scientific research must seek to bring about the most efficient utilization of wood in all possible forms. The Forest Products Laboratory, in promoting this and in developing and improving processes of wood conversion through studies of the physical, chemical, and biological nature of wood as a raw material, is making an increasingly important contribution to forestry.

Substantial recognition of this was recently accorded by Congress in providing for the construction of new and adequate quarters for the laboratory. With the expected completion of the structure during the summer of 1932 the laboratory will be in possession of first-rate, modern accommodations adequate for its present research program and providing for the considerable expansion of work that is sure to be needed within the next few years.

WOOD IN THE BUILDING FIELD

Lumber is the chief product of the forest, and more than 60 per cent of the lumber produced in the United States is used in residential, commercial, and other types of building construction. Wood has long been recognized as a relatively inexpensive building material. Yet during 25 years of enormous expansion in the building industry the per capita consumption of lumber has decreased by nearly one-half. It has lost much ground competitively because of lack of technical progress in wood use. Radical improvements are needed in the engineering of wood construction, so that the advantages of inexpensive material and simplified, efficient, and cheap erection may be combined to produce a truly economical structure.

One of the country's greatest problems is proper housing for the wage earner. In the average frame house or building, material and erection costs are about equally divided. Under present construction methods, mechanics earning \$12 to \$15 a day can not produce a house that is worth the money it costs. Hence, while productivity in every other industry has been materially increasing, productivity in housing has decreased. Great economy in all classes of construction would result if the utilization of short-length, narrow, low-grade lumber could be put on a sound engineering basis. The same may be said for the utilization of factory-cut stock sizes and of built-up standard members and panels, assuming that these can be manufactured in quantity and assembled rapidly into a finished structure. Improvement of wood-construction methods requires careful study of engineering design and thorough testing of structural combinations which go to make up the various elements of a house, such as framing and fastenings, beams and columns, floor systems, and outer and inner wall panels. Information bearing on fundamental problems in the field of design and erection was obtained by the Forest Products Laboratory during the year.

Test work on bolted joints was completed, and the preparation of a bulletin was begun which will present for the first time a set of comprehensive and dependable working stresses for such joints, as well as data on safe spacing and marginal allowances for bolts in wood. Tests of the lateral resistance of nails in wood proved that in holding power nails follow much the same general law as bolts, with somewhat higher efficiency.

Strengthening bolted joints by the use of special metal fastenings which act as dowels or keys offers great promise of developing maximum efficiency in wooden chord members. Six devices of this kind manufactured in Europe were tested. The best of them increased the joint strength from five to six times. Standardized metal fastenings will facilitate quantity production of timber framing and rapid erection. For a given design of structure parts can be cut to size at the factory, bored and fitted for the fastenings, and shipped either unassembled or made up into larger units. Laborious hand fitting on the site is thus replaced by quick and exact mechanical work, and added value is given to wood as an engineering material. The laboratory tests were aided by the cooperation of the National Committee on Wood Utilization.

Significant engineering data were obtained in a new study of laminated construction. Of necessity much of the lumber produced

at all mills is stock of short length, small dimension, or low quality, the sale of which is a major problem. If structural members of satisfactory strength can be built up of such material, much of the wood that now goes to waste or is disposed of at a loss can be made a source of profit. Work in this field was carried forward with the cooperation of the National Lumber Manufacturers' Association.

Most study was given to the built-up column formed by nailing. A number of column types were built full size and tested, developing strength from 27 to 91 per cent of that of solid wood members. Short lengths did not materially diminish the strength. Two possibilities of great value are opened: (1) Replacement of solid columns of any required strength with somewhat larger columns built up of cheap material and (2) the mass production at the mill of long columns that are hard to obtain in solid material, for use as a whole or in sections.

Studies of built-up beams were begun. The objective in view is to obtain satisfactory members from units laid one above the other, so that high-class material need be used only toward the top and bottom where stresses are highest, inner layers being filled in with lumber of lower grade. The work has gone far enough to show that ordinary means of fastening are insufficient for the purpose, and gluing under the most carefully controlled conditions is now being tried. Studies of the laminated arch are planned with a view to encouraging large-scale production of efficient units, particularly for modern auditorium, factory, warehouse, and barn construction.

Closely allied with improved fabrication and construction methods as means toward holding and enlarging the structural market for wood is the securing of lasting and satisfactory service from wood in the completed building by proper grading, selection, and seasoning, and by measures that insure economical maintenance and good appearance.

Further analysis of the defects of commercial softwood lumber species gives a new and significant basis for selecting lumber to meet the requirements of specific uses. The findings of this study were assembled in mimeograph form and distributed to representative producers and associations for information and for use in grade revisions, pending preparation of a bulletin for general circulation. Species were classified as to the kind and prevalence of knots and the amount of pitch, shake, decay, stain, checking, and other defects as they occurred in 8-inch boards.

With the assistance of the laboratory, lumber producers made more progress this year than in any equal time before in bringing structural grades for the leading timber species into accord with Forest Service recommendations. This means that an engineer designing timber framework can detail sizes which have been definitely proved by test to be able to carry the required loads most economically with safety. A circular explaining the application of the recently adopted American lumber standards to the lumber purchased by the farmer, contractor, and home builder was published.

The most prolific source of trouble with lumber in ordinary service is the use of material seasoned to the wrong moisture content for the conditions it encounters. Natural adjustment causes excessive swelling and shrinking, with attendant damage such as weathering,

warping of panels, cracking or bulging of flooring, sticking of doors and settling of framework. Steady progress was made in the various phases of the wood-seasoning and moisture-equilibrium problem—determining regional moisture conditions, improving standards of kiln-drying, devising instruments for the easy measurement of wood moisture, and studying methods of storage and handling to prevent undue moisture changes in stock after drying.

A report analyzing data obtained in the nation-wide survey of moisture content of wood in dwellings was completed for publication. With the aid of these data and weather maps it is now possible to plot the wood-moisture zones of the whole country at any season. Regional averages for wood moisture in houses and in house parts, from attic to cellar, have been determined. Further work is needed to apply this new information as a guide in mill and building practice, but if the conditions indicated are properly met the woodwork problem of the typical dwelling is permanently solved. Incidentally, it was proved that an increase of 8 per cent above the moisture content present at the time of construction is sufficient to ruin the most carefully laid floor, and that as a rule a change greater than 4 per cent should not be allowed.

The control of seasoning so as to reduce moisture variations and degrade of lumber was further studied. Particular attention was given to the internal and external physical factors that operate in the kiln-drying of Douglas fir, and drying schedules were worked out for wide clear material to secure rapid drying with minimum damage to stock. The data on several years' study of Douglas fir seasoning are now being analyzed and assembled for publication in bulletin form.

An experimental portable dry kiln was tested on two locations with charges of southern pine. From the results of these runs it is probable that a practical kiln design can be developed for the use of small-mill operators, so that the large volume of lumber produced at these mills can be marketed in better and more salable condition.

That the laboratory's long advocacy of better seasoning is meeting with effective response throughout the industry was evidenced by many inquiries and requests for technical publications. Forced circulation as an important factor of kiln operation gained wider recognition. It was reported that one concern had manufactured and installed in kilns 10,000 internal fans of a design originated at the laboratory. Experiments demonstrating the efficacy of increased air movement in the drying of Douglas fir were instrumental in influencing producers to adopt this year the first moisture specification applying to that species. Many operators manifested interest in the "sliver machine," a simple apparatus recently developed for gaging moisture conditions in lumber seasoning and storage piles, and about 150 of these instruments were put in service. The "blinker" electrical machine for the quick determination of wood moisture, the technical development of which was completed a year ago, passed into commercial production at two manufacturing plants.

In the study of lumber storage and handling problems now in progress it is much easier to note examples of bad practice than to define the conditions that insure final delivery of material meeting

high market requirements. The first objective is to fix practical standards for shed storage. Measurements taken in the tall closed sheds of a western plant showed a humidity condition toward the bottom of the lumber stack sufficient to raise the moisture content of the better grades of stock to an undesirable degree. At the top, fluctuations of humidity corresponding to daily and seasonal variations of roof temperature occurred. These facts point to the desirability of some provision for heating and air circulation in tall sheds, for the better grades of lumber. Attention was given to the question of shed-roofing material, but no decisive difference was found between wood and metal in point of humidity effect. Studies of open and closed and of heated and unheated storage sheds were continued, and the scope of the work was broadened by the cooperation of additional producing and consuming plants.

Unmeasured commercial possibilities are bound up with anti-shrinkage treatments for wood, a study of which was started. An effective antishrink treatment of green material, besides simplifying wood drying, would fundamentally modify the shrinkage and swelling problem and its multiple variations. From the preliminary work within the limitations of the small funds available, interesting results were obtained. Experiments with impregnating chemicals were emphasized, with secondary attention to coatings and treatments to block moisture changes. A heavy impregnation with cane sugar reduced shrinkage about 50 per cent. Impregnation of wood with ammonia gas also showed a marked effect in controlling shrinkage and distortion. Not only empirical testing but largely augmented fundamental research on wood structure and composition ought to be directed to the solution of the shrinkage problem, in view of its far-reaching importance.

The effort toward better maintenance of wood in service included studies of decay prevention, painting, and fireproofing methods. The susceptibility of wood to damage by decay fungi, insects, and other harmful agencies has undoubtedly lessened the use of wood in house building and general construction. From inquiries received it appears that decay and termite infestation in buildings are increasingly serious problems. A new series of tests indicated that even blue stain, formerly regarded as not affecting strength, decreases the toughness of wood and reduces breaking and compressive strength in a considerable degree.

From the results of tests covering a period of many years a general law was formulated relating the toxicity, solubility, and chemical structure of preservatives. This accomplishment promises to lead to two important results: Prediction in advance of the preservative efficiency and service life of any given chemical, and the discovery or postulation of the "ideal" preservative composition, namely, one of maximum penetration and toxicity and of minimum leaching tendency. The degree to which any given chemical approximates this composition will then determine its preservative value. The findings of this study apply both to oils and to water-borne toxic materials. Since the latter are preferred for wood used in building, a scientific basis for judging the most satisfactory and practical preservative for use in the pretreatment of lumber has been provided. Incidentally, the laws applying to wood preserva-

tives appear to hold good for toxic materials in general, including those used in the control of crop pests and in the treatment of disease.

Six-year exposure tests have shown that the life of paints now generally used on wood is determined in large part by the characteristics of the wood itself. A leaflet was published explaining this relation and classifying American softwoods according to their paint-holding power. At the request of prominent paint technologists additional painted panels were exposed on test fences in the East, West, and South to determine the effectiveness of different priming coats. As a check on previous conclusions regarding the effect of extractives, a number of hemlock panels were exposed which had been treated with extractives of cypress, redwood, and western yellow pine before painting. Since hemlock wood is relatively free of extractives, the behavior of these "hybrid" panels should clearly isolate any effects due to extractives alone. Paint-adhesion studies of hardwoods were begun with the exposure of panels of 14 species, and a large number of softwood panels that had completed their life under test were received and examined.

Intensive studies were made of the fireproofing efficiency of five salts previously tested in a general way. These chemicals were injected into wood in varying amounts up to about 8 pounds of dry salt per cubic foot of wood, and the behavior of the treated wood in the fire tube was carefully studied. It is possible to give to wood, by any one of several treatments thus far examined, a degree of fire resistance adequate for many building purposes, but less expensive methods must be found to place the treated wood within reach of the average consumer. When this object is attained, one important factor contributing to the \$500,000,000 annual fire loss in the United States will be virtually eliminated, and there should be less discrimination in city building codes against wood as a fire hazard.

CONVERSION OF THE LOG INTO LUMBER

Economic stability and profit in forest growing and utilization require more efficient conversion of the stand into sawed products to meet the demands of established markets. The lines along which this problem is being attacked are selection of the tree for profitable cutting and sustained yield, improvement of mill practice, and the utilization of low-grade logs and little-used species.

An extensive survey of sawmill waste in the Douglas fir region was made by the Pacific Northwest Forest Experiment Station to determine the quantity and form of wood waste resulting from the manufacture of rough green lumber, and also the present utilization of this material. This survey showed that in 1929 the mills of western Oregon and Washington, in manufacturing 10,286,000,000 board feet of lumber, produced over 619,000,000 cubic feet (solid measure) of so-called sawmill waste. For every cubic foot of sound wood in the saw logs approximately $7\frac{1}{2}$ board feet of lumber was produced. Of the remaining material 44 per cent was reclaimed by the sawmills and sold as lath, handle squares, pulpwood, pulp chips, fuel wood, sawdust, etc.; 29 per cent was used by the sawmills as fuel in the production of power; and 27 per cent was sent to the burners and destroyed as true waste. The results of this survey will be published serially in a lumber journal.

A comprehensive report on logging-output studies was prepared for publication by the office of forest products in the Northern Rocky Mountain region. This reports covers a series of studies begun in 1923. It analyzes the effect of various factors on output and presents numerous carefully prepared graphs on sawing, horse skidding, tractor skidding, donkey skidding, loading, unloading, and various methods of transportation other than skidding.

A preliminary analysis of the results of the comprehensive woods and mill study in California by the California Forest Experiment Station indicated that it does not pay to saw lumber from western yellow-pine logs 14 inches and under in diameter, as the costs are greater than the value of the lumber. The study also indicates that sugar-pine logs 14 inches in diameter and under, white-fir logs 20 inches and under, and incense-cedar logs 13 inches and under can not be sawed into lumber at a profit.

Data obtained from logging and milling studies made in the second-growth loblolly pine and hardwood forests of the Atlantic coastal plain were analyzed, and the results of the work in Virginia are to be published in a bulletin by that State. The results of similar studies in the Gulf coast region were made ready for Government publication. Briefly, the findings are that it is much more costly to handle small trees than large ones, and that the lumber is worth less per thousand board feet when cut. Highest returns per acre are obtained when no trees less than 12 inches in diameter, are cut from Arkansas second-growth forest-grown shortleaf and loblolly pine; none less than 15 inches from Louisiana old-field loblolly; and from Virginia and North Carolina loblolly of the forest-grown and old-field types, none less than 12 inches and 11 inches, respectively. For virgin shortleaf in Texas and western Arkansas the diameters for greatest profit per acre were found to range from 10 to 14 inches, according to the type and the age of the stand. While a knowledge of cutting limits is of great value to the lumberman from the standpoint of operating profits, the most important use for the data is in developing practical plans for selective cutting as a means of introducing permanent forest management. The foregoing figures relate to utilization for lumber only. Studies to follow will embrace second-growth stands of longleaf and slash pine in which lumber cutting is supplementary to turpentine and pulp production.

Direct correlations between lumber values and silvicultural factors were worked out in the North Carolina loblolly pine stand. There it was found that plots with the greatest and the smallest density of stocking gave respectively the lowest and next to the lowest return per acre; in the one case logging costs were high because of small trees, in the other lumber grades and values were low because the open spacing induced heavy growth of limbs. The percentage of high-grade lumber was influenced also by the proportion of hardwoods present. The highest percentage of B and Better pine lumber came from a stand of intermediate density in which the basal area of hardwoods was about one-third the total basal area. These and other relations bear directly on the profitableness of silvicultural methods such as planting, thinning, and, possibly, pruning.

Work toward improving the methods and products of the small mill took on added interest with the study of a portable band mill of advanced type on a North Carolina operation. The whole mill,

with efficient log-handling and carriage equipment and a band saw cutting a $\frac{3}{32}$ -inch kerf, is mounted on a standard-gage flat car and moved by rail to advantageous locations as logging proceeds. From actual measurement and grading of its output it was shown that such a mill will average about \$7 per thousand board feet, log scale, better gross returns than a large stationary band mill operating on the same class of material, and \$10 better returns than a portable circular mill.

Several chapters were completed for a proposed loose-leaf handbook for small-mill operators. These deal principally with machinery adjustments for more uniform sawing and with sound methods of cost finding. Progress was made in developing practical dip-tank equipment. This work supplements the notably successful research of the Bureau of Plant Industry on chemical dipping solutions to reduce blue staining of lumber. Work on the portable kiln, previously mentioned, and on a grading stick for the use of the sawyer and edger man in improving the cut from hardwoods, are other features of the small-mill program which promise favorable developments.

Small-dimension stock apparently offers one of the most profitable forms into which low-grade and defective hardwoods can be converted. This type of material presents a special problem in New England. A study of the economics of small-dimension production from birch and maple was accordingly undertaken in that region. The results thus far indicate that bolts (short log sections) yield about 50 per cent more usable material on sawing than do logs, and that milling costs are 100 per cent higher for 5-inch than for 19-inch logs. Seasoning experiments in connection with this work showed definitely the allowances necessary in sawing to give any desired finished size. As part of the study, it is proposed to determine minimum sizes of logs that pay their way through the small-dimension mill and to compare the merits of the several milling systems in use. A departmental circular on the previous study of small-dimension stock from Lake States hardwoods was published and distributed throughout the industry.

Publications on the utilization of little-used species included a bulletin on the woods of Alaska, the first edition of which was quickly exhausted, a bulletin on properties and uses of Lake States aspen (issued cooperatively by the University of Minnesota), and a number of journal articles addressed to prospective users of chestnut. A bulletin on properties and uses of western larch was prepared for publication.

CHEMICAL CONVERSION OF THE TREE

The conversion of wood into useful commodities through pulping and other chemical processes holds out most challenging possibilities for the profitable utilization of little-used species, small and defective trees, and logging and milling wastes.

An entirely new plastic material appeared within reach as the result of treating partly hydrolyzed wood or sawdust with aldehydes such as furfural, itself a wood derivative. In formation and general properties, the new material seems analogous to the condensation products of aldehydes and phenols that have come into wide commercial and industrial use in the last decade. It can be

molded and sawed, it takes on a lustrous finish in the press, within certain limits it can be colored, it is dense and strong, and it has no appreciable tendency to swell or warp on exposure to moisture. The further study and development of this material will be actively followed up.

Pulping research is being conducted on a regional basis which accords with present economic trends. Among western woods, experiments with Douglas fir gave very satisfactory results. Good bleached pulps, suitable for book and bond papers, were produced by use of the laboratory's modified sulphate process. This procedure followed by a 2-stage bleaching, in which one stage is chlorination, met with considerable success in producing a white paper. Experimental sulphite pulping of Douglas fir yielded fairly satisfactory pulps of a bleachable character when the usual lime base was replaced by ammonia. Use of these bases involves a recovery system, details of which are being worked out under a special project.

Unless all signs fail, the results of laboratory research on the pulping of southern woods will soon find important application in large-scale commercial developments. Interest in this field is running high. Slash pine as a raw material for newsprint is attracting widespread attention. Experiments this year demonstrated that the commercial sulphite process gives satisfactory pulps from slash pine free of heartwood, and earlier investigations have shown that ground-wood pulp of satisfactory color and average strength can be produced from young slash pine with reasonable power expenditure. While rapid growth of the tree is eminently desirable for maximum volume of pulps, late studies prove that as a rule slow-grown material yields pulps of somewhat higher strength. Some compromise between extremes of growth is therefore in order.

For most commercial white papers resin-free wood is essential. A new pulping process developed by the laboratory may, however, effectively eliminate this requirement. It consists of a "semichemical" impregnation treatment of the wood with sodium sulphite and sodium bicarbonate, followed by ordinary calcium sulphite cooking. Applied to resinous longleaf and slash pines, it produced a strong bleachable pulp comparable in quality to standard sulphite. The horizon of usefulness as paper-making material not only for southern pines but also for a large group of northern and western species will be indefinitely widened if the new process, so successful experimentally, proves adaptable in practice.

The modified sulphate or kraft process gave an excellent account of itself when applied to slash pine, as was confidently expected from the experiments with loblolly and longleaf previously reported. Shortleaf and minor species of southern pine will comprise the next phase of this work.

Studies bearing on the technical control of paper making and the evaluation of paper and pulp were vigorously prosecuted, with the ultimate object of developing to the full the potentialities of any wood pulp under investigation as paper material. An important feature of the work was the installation on the laboratory paper machine of specially designed equipment to give positive control of all operating variables, including the speed of drive in all sections, press and calendar pressures, the temperature of stock and of driers, and shake frequency. Further development of screen-

analysis methods resulted in a significant correlation between fiber length and pulp quality. Apparatus for pore-volume measurement was improved in accuracy and used in a number of cases for the evaluation of papers.

WOOD, THE RAW MATERIAL

The successful adaptation of any raw material to diversified markets and its transformation into new products generally requires an increasing knowledge of the material itself. With wood this is an exceptionally difficult matter because of the variability and complexity of its substance as a chemical and biological aggregate. Nevertheless a very useful general picture has been built up. Last year brought significant additions to knowledge of the composition, structure, development, and properties of the material.

Progress in the production of a new plastic from wood by treatment with aldehydes has been described. A curious feature of this study was the creation of a similar plastic by the treatment of hydrolyzed or unhydrolyzed wood with phenols; that is, either component of commercial plastics now widely used will combine with wood to make a similar product. Whether considered as a clue to wood composition or an added complexity, this finding commands further attention.

The effects of heat and cold in the chemical isolation of lignin from wood were studied. Evidence indicates that much of the lignin obtained at ordinary or high temperature by accepted methods consists of impurities or degradation products from cellulose that add complications to the study of a practically unknown compound. Isolation of lignin at reduced temperature gave a smaller amount of material, regarded as much purer. Its lighter color approximates that of the original wood.

The X ray was used in a study of the development of cell structure in the living tree. The work has proceeded only far enough to show how sharply the cellular or quasi-crystalline formation is confined to the wood and bark outside the thin layer in which the growth process is at work. The search for transitional material, if successful, should furnish useful data for the physical and organic chemist in working out the molecular arrangement and composition of cellulose.

Research on wood extractives included a careful determination of the resin content of young slash pine, which clarified the problem of pulping this species. While the average proportion of resin in the young tree is not high, there is a marked increase of resin toward the center, causing pulping difficulties that would not occur if the distribution were more uniform. Sufficient resin to cause trouble was found in slash pines 30 years old, even though no true heartwood had been formed. The study showed rather definitely why a higher percentage of screenings result in the sulphite and mechanical processes of pulping slash pine, and suggests that these processes might better be restricted to even younger trees.

Considering the extractive from the opposite standpoint of naval stores production, a careful analysis of the oleoresin of slash pine was made as the first step in a thorough study of biochemical factors which influence oleoresin formation, in quality and quantity. In the course of the experiments information on water extractives and

oxidation products of the resin that effect its commercial grading was obtained. In a further study of the extractives of western red cedar an organic acid was isolated which may account entirely for the corrosive effect of this wood on certain metals. Three extractive compounds derived in series from redwood were also identified and named, and their chemical kinship to other wood extractives was established.

With a view to facilitating the movement of liquids through wood, an attempt was made to enlarge the effective cross section of the minute openings in the pit membranes of the wood cell, which are the seat of the major resistance to flow. A drastic treatment of short specimens of Sitka spruce with moist chlorine gas followed by treatment with ammonia gave more than a hundredfold increase in permeability but practically destroyed the strength of the wood. Less drastic treatment gave a thirtyfold increase in permeability and only a slight reduction in strength. Treatment of Douglas fir specimens a foot long increased permeability two to five times. The process has possible application to the impregnation of difficult woods with chemicals, as in preservation and pulping.

A bulletin summarizing the laboratory's studies of wood-liquid relations, covering hygroscopicity, capillarity, and rate of diffusion and drying, was prepared for publication.

Further progress was made in relating the properties of wood to conditions of growth, structure, and service. Mechanical properties have been accurately related to moisture content, and a revision is now under way of the laboratory's data on mechanical properties, referring all strength values to a moisture content of 12 per cent, which represents an average air-dry condition of the wood. The number of species covered by the data will be increased from 116 to 160 as the result of recent tests. In a study of regional influences on properties of wood, no significant difference was noted in the strength of Sitka spruce and Douglas fir grown in Oregon as compared with that of the same species grown in Alaska, whereas considerable differences in strength were found between Douglas fir of the coastal type and of the mountain type.

This confirms the view that mere geographical location of the stand is of no weight in comparison with immediate silvicultural factors as an indication of the strength of wood. The effect of site conditions was strikingly illustrated in the case of a 25-year-old planting of pines in a sandy location. Cuttings from the stand revealed extraordinary weakness and brashness, and an examination of the wood showed poor and irregular development of the summer-wood bands. This example points to the need of carefully appraising the effect of environmental factors on quality as well as quantity of yield before embarking on any large adventure in artificial reforestation.

By examining and testing a large number of samples of normal and abnormal material it was possible to work out a general law relating the longitudinal shrinkage of wood to its structural characteristics. In normal wood, in which the fibrils approach parallelism with the fiber axis, longitudinal shrinkage decreases as specific gravity increases, until in extremely dense material a slight "negative shrinkage" (elongation) occurs on drying. In material of the compression-wood type, in which the fibrils have a pronounced slope

with respect to the fiber axis, increasing specific gravity brings with it progressively greater shrinkage lengthwise. Thus high specific gravity, which is generally a test of excellence, falls under suspicion in cases where the material contains compression wood or similar growth, a fact which makes visual detection of the abnormality all the more important.

An interesting confirmation of the theory that leaning trees are a frequent source of compression wood was afforded by certain pine trees that had been subjected to the Florida hurricane of September, 1926. About one-third of the sample trees cut from the stand in question were found to have produced heavy compression-wood growth on one side of the 1926 annual ring, and decreasing amounts in rings of succeeding years. Since most of the compression wood was found in the upper part of the stems, the inference is justified that the storm, whipping over the tops, caused severe bending, which the trees gradually corrected by the formation of compression wood as a brace. The action of winds from various directions would, in general, account for the sporadic formation of compression wood observed in the cross section of many trees.

A bulletin on brashness in wood, summarizing several years' studies of this major defect, was prepared for publication. The occurrence of brashness may be due to any one of several causes, among which the bulletin notes compression wood, compression failures, low density, and incipient decay. Methods of visual detection of brash material are explained.

A mathematical analysis of the elastic behavior of wood as a non-isotropic material was begun. This study is intended to correct some very common engineering assumptions by correlating the stresses and strains of wood directly with its structure in concentric layers, a formation which acts very differently from a uniform body.

RANGE INVESTIGATIONS

An analysis during the year by the Intermountain Forest and Range Experiment Station, of data accumulated during 15 years of study of the restoration of depleted mountain range lands in central Utah, shows a close relationship between the depletion of the soil, following destruction of vegetation by overgrazing, and the ability of the range to recover. Areas on which the soil was badly depleted in 1915, and which at that time produced chiefly annual weeds, required about 36 acres to support a cow for a month. These areas now produce a scant stand of grasses and a rather good stand of other herbaceous perennials, but still require nearly 10 acres to support a cow one month. Areas on which the soil was only moderately depleted and on which some grasses remained 15 years ago, now produce a fair stand of grass and a good stand of other perennial herbs, and require $3\frac{1}{2}$ acres to support a cow a month. On areas where neither soil nor forage was depleted 15 years ago the more palatable plants have been maintained, and only 2 acres are required to support a cow for a month.

Sowings of several cultivated forage plants which had been made several years ago in the oak-brush zone of central Utah by the Intermountain station in cooperation with the Bureau of Plant Industry, reached sufficient maturity to demonstrate their ability to establish themselves under the semiarid conditions prevailing. Up to an alti-

tude of 8,000 feet the yellow sweetclovers produced good stands of vigorous plants, bloomed early, and matured seed. The best stands were produced from seed sown in furrows plowed along the contour of the slope. Substantial foliage production was made in spite of constant grazing by cattle and rodents. Similarly, crested wheatgrass proved a vigorous, rapid-growing, and drought-resistant species, which starts early in the spring, remains green until late in the fall, and withstands heavy grazing remarkably well. White sweetclover, however, was unable to withstand grazing under the dry conditions prevailing on the test areas.

The exploratory studies of spring-fall ranges in the intermountain region, authorized by the McSweeney Act, showed that considerable range values have been destroyed during the 50 to 60 years that these lands have been grazed. Three striking differences in the nature and amount of the plant cover on the ranges were revealed: (1) In areas protected from both fire and grazing for a number of years approximately four-tenths of the soil is covered with vegetation of which the native wheatgrasses and bluegrasses constitute 68 per cent and sagebrush only 11 per cent; (2) burned but ungrazed tracts also have about four-tenths of their soil surface covered with vegetation which, however, consists of only two-thirds as much perennial grass cover and one-fifth as much sagebrush as are found on the protected areas, while annual grasses having little grazing value constitute 22 per cent of the total plant cover; (3) tracts which have been grazed but which have not been burned support a vegetative cover only slightly less abundant than that of the protective area, but they furnish only three-fifths as great a grazing capacity: their vegetation consists of less than three-fifths as much perennial grass cover as in the protected areas, more than twice as much sagebrush, and a materially larger stand of annual grasses.

The results of management studies of spring-fall range in southern Idaho, in cooperation with the Bureau of Animal Industry, which have been under way for seven years, were analyzed last year. Range grazed continuously for three weeks, beginning with the start of plant growth in the spring, had lost 62 per cent of its grazing capacity, and similar range grazed during the entire spring period had lost 75 per cent. Corresponding decreases took place in the surface cover of perennial grasses and other palatable plants, whereas sagebrush increased. On the other hand, range grazed for 10 days in the spring after the palatable plants had made vigorous growth and in the fall sufficiently to make full use of the forage then available, maintained a high grazing capacity, and practically no change took place in the composition and extent of the cover, though a number of the seven years were unusually dry. Conservative grazing of the range only in the fall increased the stand of grasses and other palatable plants, while a slight decrease took place in the sagebrush cover. Such fall grazing affords the maximum opportunity for improvement of depleted ranges in the sagebrush-wheatgrass type of spring-fall range.

Interesting results on injury by livestock to western yellow-pine reproduction of different sizes were brought to light by studies of the Southwestern Forest and Range Experiment Station, authorized by the McSweeney Act. On cattle range, in one year, 4.3 per cent of the reproduction advanced beyond the seedling stage was injured

by grazing. Of 2-year-old seedlings, 14 per cent were injured and 3 per cent were killed, and of those 1 year old, 5 per cent were injured and 7 per cent killed. On sheep range, 7.3 per cent of the advance reproduction was injured by grazing; of 2-year-old seedlings, 8 per cent were injured and 1 per cent killed, and of 1-year-old seedlings, 5.1 per cent were injured and 2 per cent killed. In addition, 45 per cent of the year-old seedlings and over 15 per cent of the 2-year-old seedlings died from natural causes—a very heavy loss. These results emphasize the importance of developing effective range management methods.

The report on studies, mentioned last year, of plant succession on clay soils on the Jornada Experimental Range of the Southwestern station, in New Mexico, was completed. Drought, overgrazing, erosion by wind and water, and rodent damage are all factors in the depletion of range forage on clay soils. In the natural restoration annual and perennial weeds are the first usable plants to come in on denuded spots. Burro grass, a prolific-seeding perennial whose seeds work readily into the clay soils by long awns and which also spreads by means of stolons, or horizontal stems, that extend out from the tufts and take root to establish new plants, also appears on denuded soils, but usually follows the establishment of weeds. Because of the low feed value of these plants the grazing capacity of the early stages of succession is low. This vegetation, however, improves the humus content and water-holding capacity of the soil, thus aiding the re-establishment of plants of higher grazing value. The best stages of development are characterized by a good plant cover, dominance of tobosa grass, and range which on the average will support a cow for a month on about $3\frac{1}{2}$ acres.

EXPENDITURES AND RECEIPTS

The expenditures for all purposes during the fiscal year were as follows:

General administration.....	\$368, 860. 05
Forestry extension.....	78, 846. 88
Research:	
Silvical investigations.....	\$899, 045. 72
Forest products investigations.....	693, 632. 41
Range investigations.....	125, 042. 01
Taxation study.....	65, 642. 55
Total.....	1, 783, 362. 69
Administration, protection, improvement, reforestation and extension of the national forests:	
Administration—	
Timber use.....	\$998, 219. 47
Grazing use.....	1, 016, 234. 22
Fish and game protection.....	145, 252. 80
Recreation and land use.....	260, 513. 33
Examination and administration of power sites for Federal Power Commission.....	24, 664. 00
Classification, settlement, and claims.....	95, 454. 98
General surveys and maps.....	180, 051. 46
Grazing reconnaissance.....	96, 359. 05
Timber surveys.....	234, 898. 09
Subtotal.....	3, 051, 647. 40

Administration, etc.—Continued.

Protection—

Fire prevention and detection	\$2, 363, 442. 73
Fire suppression	2, 056, 744. 16
Protection against insects and tree diseases	462, 650. 79

Subtotal ----- \$4, 882, 837. 68

Improvement—

Construction of improvements other than roads, trails, and camp-ground improvements	1, 884, 012. 52
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Maintenance of improvements other than roads, trails, and camp-ground improvements	722, 014. 74
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Camp-ground improvements	100, 000. 00
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Construction and maintenance of roads and trails—

10 per cent fund under act of Mar. 4, 1913	763, 031. 69
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Cooperative construction of roads and trails under act of July 11, 1916	51, 565. 64
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Emergency construction, act of Dec. 20, 1930	3, 052, 616. 19
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Highways within national forests, act of Dec. 20, 1930	899, 326. 37
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Forest development roads and trails under act of Nov. 9, 1921	3, 118, 491. 16
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Forest highways under act of Nov. 9, 1921	7, 654, 564. 59
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Road and trail construction from moneys contributed by cooperating agencies under act of June 30, 1914	1, 927, 882. 33
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Contributed from other appropriations	1, 288, 843. 44
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Class total (roads) -- 18, 756, 321. 41

Subtotal ----- 21, 462, 348. 67

Reforestation—

Nurseries and tree planting	286, 280. 01
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Extension—

Land exchanges	151, 089. 04
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Acquisition under act of Mar. 1, 1911, as amended	2, 014, 411. 01
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Subtotal ----- 2, 451, 780. 06

Total ----- \$31, 848, 613. 81

Protection and reforestation of other than national forest lands:

Tree planting in cooperation with States under act of June 7, 1924	90, 798. 16
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Fire protection in cooperation with States under act of June 7, 1924	1, 633, 050. 18
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Protection of Oregon and California grant lands	74, 276. 50
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Total ----- 1, 798, 124. 84

Grand total ----- 35, 877, 808. 27

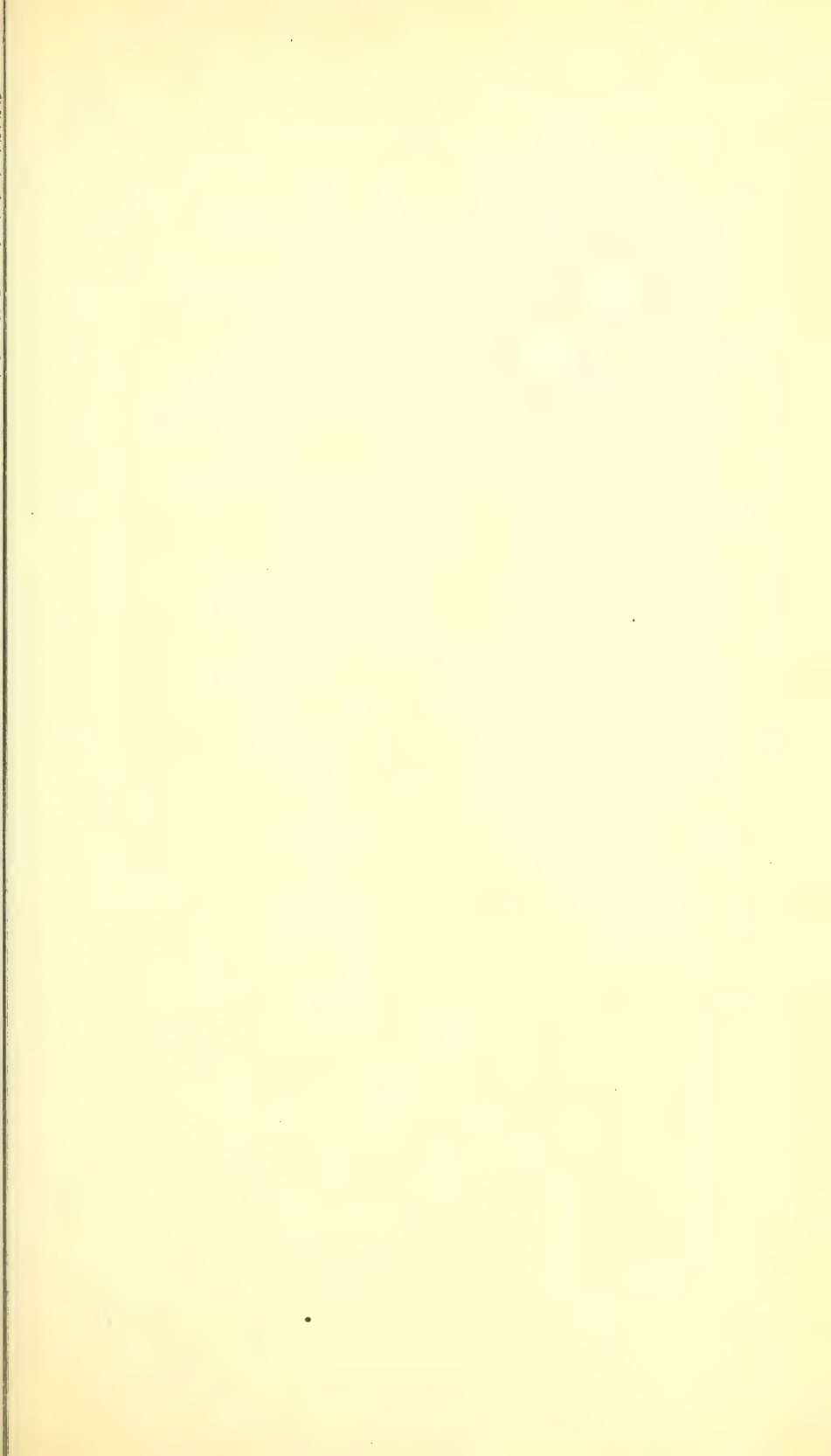
In addition to the expenditure for land extension itemized above in the entries "land exchanges" and "acquisition under act of March 1, 1911," national-forest timber having an estimated value of \$461,323 was cut under agreements involving the acquisition of land and timber through exchange. The cash disbursements recorded under "land exchanges" cover merely the outlay incidental to examining lands offered for exchange and appraising the values involved.

The cash receipts from the national forests were as follows:

From the use of timber.....	\$2, 607, 617. 70
From the use of forage.....	1, 960, 642. 32
From miscellaneous uses, including the use of land, water-power sites, etc	425, 060. 06
Total.....	4, 993, 320. 08

The total is less by \$1,758,233.14 than that for the previous year. Receipts from timber decreased \$1,782,275.30. Grazing receipts were greater by \$17,728.13 and miscellaneous receipts increased \$6,314.03.

In addition to the cash receipts from timber, there should be credited the value of the timber cut under specific agreements for effecting land exchanges, estimated at \$461,323.



REPORT OF THE FORESTER

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., September 1, 1932.

SIR: I transmit herewith the report of the Forest Service for the fiscal year ended June 30, 1932.

Respectfully,

ROBERT Y. STUART, *Forester.*

Hon. ARTHUR M. HYDE,
Secretary of Agriculture.

NEW LIGHT ON THE TIMBER SITUATION

That the timber supply of the United States is waning has long been generally believed. The Forest Service has for many years been diligently seeking better light on how much timber there is in the country, how fast it is being used up, how fast it is growing, and how use and replenishment can be brought into proper balance. Yet policy, both public and private, still has to confront many uncertainties. Business practice demands more and more the systematic gathering, analysis, and appraisal of relevant facts to clear up such uncertainties. Through the country-wide forest survey authorized by the McSweeney-McNary Act of 1928 on a 12-year basis, and now under way—though its pace will be retarded by the curtailments resulting from the governmental economy program—eventually a complete inventory of the forest resources of the United States will be obtained. As an interim measure, the Forest Service inaugurated in the fiscal year 1931 and prosecuted throughout the fiscal year 1932 a restudy of the existing data on the forest situation, obtainable without extensive first-hand field studies.

Its results afford better light than have any of the earlier estimates upon our available present timber supplies and probable future forest needs. In appraising the value of these results, however, the difficulties and complexities involved in making estimates of this character should be kept in mind.

OUR FOREST LAND

The area of forest land in the United States is not diminishing, but increasing. In 1920, after a study of the forest situation by the Forest Service preparatory to the so-called "Capper report," it was put at 463,000,000 acres. The new study shows 496,000,000 acres of forest land suitable for the production of commercially valuable timber crops. While the two estimates are not strictly comparable, the difference between them is in part because of the intervening reversion of cultivated and pasture lands to forest.

The reversion is continuing. It seems destined to add millions of acres more to the forest area. This movement raises many perplexing economic and social problems, distinct from the question of adequate timber supplies, but involving forestry as a means of using land productively. In any case, what the Nation's forest area may ultimately be is less important than the quality and quantity of timber our forest lands are going to produce; whether these lands will be more or less than the Nation needs or can advantageously use; how they will affect the question of regional adequacy of forest supplies; and to what degree public

ownership of forest lands or public assistance to private undertakings in timber growing will have to be assumed.

If timber grows where it can never be cut and got to market without a prohibitive outlay, its effect on the national timber supply is nil. In economic terms, it is permanently inaccessible. Accessibility, it is true, changes all the time. The stand improves, or deteriorates; logging costs are cheapened by new devices, or increased by higher wage levels; new transportation facilities come in, or new ways to use the wood are developed, or scarcity elsewhere advances the stumpage value; and each factor shifts the dividing line. Nevertheless millions of acres of our timberland are practically out of present consideration as a source from which to meet the requirements of the general lumber market—not necessarily because the timber is very remote, but because its quality, quantity, difficulty of logging, and location combined make the cost of utilizing it greater than the value of its product. Elsewhere, particularly in the National and State parks, considerable bodies of merchantable timber are withdrawn from commercial use and devoted to scenic protection, recreational use, and the protection of watersheds. Public demands of this character are increasing. Again, as farm land in the eastern United States reverts to forest, it may often be occupied indefinitely, unless artificially reforested, by worthless or nearly worthless growth. Along with such land may be placed about 60,000,000 acres which lumbering and fire have either denuded or otherwise left in no condition to become again productive, without artificial assistance, over a long term of years. Much land of both kinds, though classed as forest land, can not be counted on as a source for meeting the national lumber needs for many years—perhaps not during the present century.

In its new estimate of the amount of land available for timber production the Forest Service has not attempted to segregate and exclude the forest lands which, in consequence of economic inaccessibility, are out of immediate practical consideration as a probable source of commercial-timber supply. Neither has it excluded reverting farm lands which a forest growth has actually begun to occupy, nor cut-over lands, however poor their condition, on the ground that without artificial assistance their restoration to productivity may be long delayed. On the other hand, the estimates do exclude—as did also the Capper report estimates—approximately 100,000,000 acres of low-grade woodland and scrub which has not borne and will not produce saw timber in sufficient quantity to justify large-scale commercial operations. The new estimate also excludes—and in this it differs from the Capper report—more than 10,000,000 acres of land supporting or suitable for producing commercial timber in commercial quantities, but withdrawn from timber cutting for such purposes as preservation of scenery, recreational use, and watershed protection. Thus is reached the estimate of a present commercial-forest area of 496,000,000 acres of which 189,000,000 acres, or three-eighths, bears saw timber, one-fourth bears cordwood, and the remaining three-eighths ranges from fully stocked areas of young growth not yet big enough for cordwood down to bare land.

Saw-timber areas are areas on which a large proportion of the timber is of sufficient size for manufacture into lumber, under the prevailing logging and milling practice of the region. On cordwood areas—"cordwood" is a measure of size, not use—the bulk of the timber is below saw-timber size but large enough for pulpwood, fuel wood, or similar small products. This may or may not be on the way to becoming saw timber as the present stand matures.

The forest area on which the growth is below cordwood size comprises 186,000,000 acres. Were our whole forest area on a basis somewhat approaching a condition of continuous timber production, or sustained yield, only 100,000,000 acres would be in this class. On the other hand, the cordwood area is disproportionately low. Regionally the disproportion is in some instances more pronounced. Of the 56,000,000 acres of forest land in the Lake States, for example, 42,000,000 acres is land on which the growth is below cordwood size. From the standpoint of area only, saw timber is in reasonable balance nationally, but not regionally. Four-ninths of the saw-timber area is in the West. The preponderant position of the Pacific Northwest saw-timber area is increased when the relative volumes of the timber are taken into account. More than seven-tenths of the eastern forest land is partly or wholly occupied by regrowth either too small or too poor in quality for lumber.

OWNERSHIP OF THE FORESTS

In the matter of ownership, the outstanding fact is that in the East public ownership embraces only 4 per cent of the forest land, while in the West it embraces 65 per cent. Approximately 88,000,000 acres of the commercial forest area, of which 75,000,000 acres is within the national forests, is owned and managed by the Federal Government, about 9,500,000 by the States, and more than 1,000,000 by counties and municipalities. For the country as a whole, the proportion of publicly owned forest is decidedly less than in most European countries.

Farm woodlands comprise 127,000,000 acres, mostly in the East. They make up one-half of the forest area in the central and one-third that in the Middle Atlantic and southern regions. Partly because of rough selection methods of cutting, and with less fire loss, farm woodlands are on the average in better growing condition than other privately owned forest lands.

The remaining 270,000,000 acres of private forest land is owned by land, lumber, pulp and paper, and mining companies, railroads, and miscellaneous individuals or agencies. It is in this broad class that the forest-land problems of the Nation especially reside. It includes the bulk of the nonrestocking cut-over land. It includes also most of the perhaps 30,000,000 acres or more of cut-over forest land which is tax delinquent and largely makes up the so-called new public domain. With some notable exceptions, these owners have not been convinced that it will pay them to keep their land permanently productive.

TIMBER VOLUME, GROWTH, AND DRAIN

Pending the completion of the forest survey, it is necessary to use principally cruisers' estimates as the primary source of statistical information on existing supplies of timber. These afford an exceedingly imperfect picture of what the forest actually contains and will eventually yield under utilization. They are based upon the logging and milling practices current in the various regions. These practices both vary in different regions and change from time to time in the same region.

Reasonably dependable estimates of the rate of growth which is taking place and can be forecast are even more difficult to make because of inadequate knowledge and the multitude of factors and diversity of conditions involved. Nevertheless, the studies of growth which have been under way in the various forest regions for many years have built up a large body of data, and the collective expert judgment expressed in the estimates can, it is believed, be accepted as broadly representative of actualities.

The estimates of drain are of very uneven validity in the various items. The drain for such purposes as lumber manufacture, pulp production, and the like is known within close limits, but the drain for fuel wood and the losses due to insect infestations, tree diseases, and even fire, involve elements of doubt that necessitate the allowance of a liberal margin for possible error.

The total volume of standing timber on the commercial forest land in the United States is estimated at 487,000,000,000 cubic feet. The total estimated yearly drain of 16,306,207,000 cubic feet is about one-thirtieth of the present available supply, assuming that the entire stand can be regarded as available for use—that is, disregarding the factor of accessibility.

For the old-growth timber, inaccessibility is a factor which can not be ignored. Excluding from consideration stands of barely merchantable size, it is roughly estimated that not more than one-half of the present saw timber volume of 1,668,000,000,000 board feet can be profitably harvested on the basis of present operating costs and market conditions of 1925-1929, and that on this basis only about 600,000,000,000 of the 1,314,000,000,000 board feet of saw timber in the West is available. To what extent this condition will change either way is impossible to predict.

Softwoods make up about 89 per cent of the saw timber, but hardwoods furnish 26 per cent of the cut. Hardwood depletion is therefore progressing especially rapidly. While 90 per cent of the softwood saw timber is west of the Great Plains, the hardwoods are almost entirely in the East.

Arithmetically, the figures just cited would support the statement that if the drain is not lessened, 30 years hence there will be in the United States only the amount of timber which growth in the interval will have added. Inasmuch

as the estimated present rate of growth is less than one-half the estimated current drain, the conclusion might be drawn that the country is fast rushing toward forest denudation. In reality the matter is not so simple. Undoubtedly changes will take place in both the growth and the drain rates. The crucial question concerns a different kind of exhaustion. It is a question not of reaching the end either of the country's timber supplies or of its forests, but of maintaining or enfeebling the power of the forests to grow continuously the kinds and quantities of wood that our economic life will require.

The volume of second-growth saw timber is far below that necessary for well-balanced forest resources. This is partly because second-growth stands are very commonly cut as soon as they have a money value, without regard to the fact that they are immature and growing rapidly. This practice destroys the well-balanced series of age classes necessary for sustained yield of saw timber.

The great remaining western timber reservoir, with its 1,314,000,000,000 board feet, if accessibility is left out of account, ought to serve as a means of bridging the gap until the eastern forests can be put in a more productive condition. Highly efficient methods of lumber manufacture and low-cost water transportation place this supply within reach of eastern consuming centers, and should facilitate a period of reduced cutting and rehabilitation of the depleted eastern forests. But the pressure upon private owners in the Pacific coast region to liquidate stumpage is causing lumber to be thrown on the market with little regard to future needs, depressing and dislocating the market and rendering forestry measures less attractive for private forest owners everywhere. At the same time overcutting is taking place in many of the forest regions, thus further unbalancing the situation.

The condition of unbalanced forest areas and volumes both nationally and regionally; the overcutting of second growth; the understocking of large areas of young growth and the complete denudation of 60,000,000 acres of land, because of fire and bad logging practice; the replacement of valuable species with those of no or little present usability; all these things and more find their result in marked impairment of the economic and social values which depend upon our forest resources. This dependence relates not only to the commodity value of forests, but also to their service in the fields of watershed protection, recreation, fish and game conservation, and scenic values.

What has been said merely exemplifies the highly unbalanced conditions which have resulted from public policies consisting too largely of inaction and reliance upon *laissez faire* to find and apply the necessary correctives. In comparison with the need, far too little is being done to facilitate and encourage private forest management; public policies of forest acquisition and administration are still exceedingly inadequate; and public restraint of injurious private practices through regulatory requirements has barely begun. While policies and measures designed to promote conservation have had some effect on the balance, they have been insufficient to offset the powerful and relentless pressure of the economic forces created by the pursuit of private profit. These offsetting public policies are being enlarged, but not adequately, and a demand is now developing for diminished public activities, in the name of economy and on the ground of overexpansion of the governmental function. The lumber industry itself, in the grip of economic forces which it appraises as beyond its own power to control, is seeking public aid. It desires this for the purpose of obtaining a better balance between its output and markets and lightening the burden imposed by overinvestment and overexpansion. The creation of the Timber Conservation Board was to this end. The lumber industry realizes that if public aid having any prospect of adequacy for its effective relief is to be forthcoming, this aid must comprise measures designed not solely for the stabilization of the industry, but designed also to stabilize the basic situation and the forces which are leading on to still greater unbalance in the adjustment of forest use to the forest resource.

COST ACCOUNTING

From the beginning of its administration of the national forests the Forest Service has unceasingly sought to make its expenditures of public funds full productive through efficiency in management and economy in operation. To this end it has given constant attention to the improvement of its business methods. The development of an effective system of financial control as a

executive tool has for some years been a subject of special study. It has included a search for reliable cost-finding methods adapted to national-forest conditions. Out of this has come a comprehensive cost-accounting system, which has been elaborated and determined through extended experimentation. The system and its gradual development were briefly described in last year's report. Its installation is now being completed. When the results are fully available, true costs, including overhead and appropriate depreciation charges on capital investments in facilities, will be known for every activity and function carried on.

With the relation between the cost and the benefits of each activity clearly established and its use as a tool in planning and management control definitely provided for, informed and discriminating decisions on what is and what is not of advantage to the public interest will be facilitated. The system has large flexibility. For example, forest supervisors who want complete details on specific elements of cost, such as the cost of pack-animal transportation, the cost of grazing supervision, maintenance costs on trails, or any other part of their business, can get the information they individually need in the most usable form; but those who have no occasion for these detailed data for their particular managerial task will not collect them. The system has to apply to a form of organization and a range of activities and objectives widely unlike those encountered in any other cost-keeping organization. It has been painstakingly contrived to meet the actual needs of local managers of national forests, upon whose ability to put it to real use depends its chief value as a working tool.

LEGISLATION OF THE YEAR

The Federal legislation of the year specifically relating to the work of the Forest Service was enacted at the first session of the Seventy-second Congress. The acts making appropriations were:

The first deficiency appropriation act, Public, No. 5, approved February 2, 1932. This act carried an appropriation of \$4,260,000 to cover the deficit incurred by the Forest Service in fighting forest fires during the 1931 fire season.

The agricultural appropriation act, fiscal year 1933, Public, No. 269, approved July 7, 1932.

The so-called destitution relief act, Public, No. 302, approved July 21, 1932. Under this act \$5,000,000 was appropriated for the construction and improvement of national-forest highways, and \$5,000,000 more for the construction and maintenance of roads, trails, bridges, fire lanes, and other objects specified under "Improvement of the national forests" in the agricultural appropriation act, fiscal year 1932 (46 Stat. 1242).

The acts making or authorizing changes in the area of the national forests, or affecting national-forest lands, were:

The act approved February 25, 1932, 47 Stat. 55, adding 19,407 acres to the Cache National Forest, Idaho.

The act approved June 30, 1932, 47 Stat. 474, adding 51,335 acres to the Idaho National Forest, Idaho.

The act approved May 14, 1932, 47 Stat. 155, which transferred 973 acres from the Rogue River National Forest, Oreg., to the Crater Lake National Park, Oreg.

The act approved June 18, 1932, 47 Stat. 324, granting rights of way across the San Bernardino National Forest to the Metropolitan water district of California.

The act approved May 4, 1932, 47 Stat. 146, granting rights of way to the city of San Diego, Calif.

The act approved June 30, 1932, 47 Stat. 451, extending the forest-exchange act to certain townships adjacent to the Siuslaw National Forest, in Oregon.

Legislation relating to or affecting national-forest administration comprised—

The act approved June 30, 1932, 47 Stat. 473, authorizing the Forest Service to enter into contracts for services and supplies to be furnished in the following fiscal year if an appropriation were made to meet the obligations of such contracts.

The act approved June 29, 1932, 47 Stat. 343, prohibiting the use of official insignia, except when authorized under regulations prescribed by the head of an executive department or independent office of which the wearer is an officer or subordinate.

PROGRESS IN STATE FORESTRY LEGISLATION

Georgia abolished the State board of forestry and created a department of forestry and geological development under a State commission made up of the governor, as chairman and president, and six members appointed by him. Mississippi provided that boards of supervisors shall make special assessments, not to exceed 3 cents per acre, for forest-fire protection on the timbered and uncultivable acreage of the county or definitely described part thereof, upon petition of a majority of the freeholders of the area, and prescribed the

manner of levying, collecting, and disbursing the assessment. The 1924 law relative to taxation, protection, and regulation of unimproved lands was repealed.

Mississippi designated about 23,000 acres belonging to the University of Mississippi as the University State Forest, to be under the control of the board of trustees of State institutions of higher learning. The board may issue permits and leases and sell forest products, the revenue going into the funds for the support of the university. New York amended the conservation law to permit the sale of trees, timber, and other forest products of any lands hereafter purchased by the conservation department within the forest-preserve counties but outside the boundaries of the Adirondack and Catskill parks. Rhode Island directed the commissioner of agriculture to report to the next general assembly a plan for ultimate control by the State of such forest lands as may be found suitable and available.

Alabama provided penitentiary imprisonment for not less than one nor more than five years for wilfully or maliciously setting fire to trees of any age. Mississippi enacted a law calling upon circuit judges to charge grand juries in respect to the State forest-fire laws and to instruct each grand jury to report as to the status of forest protection in the county. Rhode Island provided for the annual registration of any person, firm, or corporation owning standing trees who desires to cut or saw such trees for other than domestic use, and required portable-sawmill operators to report to the town or city forest-fire warden the location of their mills, under penalty of a fine not to exceed \$100. Virginia made landowners who set fires to clear land and negligently allow them to spread to adjoining property and persons responsible for starting any forest fire liable for all expenditures of the State or the county in fighting the fires.

At a special session of the legislature in Wisconsin a law was enacted appropriating \$500,000 for building fire lanes and roads and for other necessary fire-protection work, and directing that the work be made to afford employment to a maximum number of unemployed or partially employed citizens of the State, so far as economical administration would permit, and that it be coordinated with the work of the interim committee on the cut-over land and tax problems of northern Wisconsin.

The New York State constitutional amendment authorizing the expenditure over a period of 11 years of \$19,000,000 for the purchase and reforestation of land outside the Adirondack and Catskill parks was approved by popular vote at the general election in November, 1931.

WORK OF THE YEAR IN STATE COOPERATION

Federal appropriations for cooperative work with the States during the year as compared with those in 1931 and 1933 are shown in Table 1.

TABLE 1.—*Appropriations for State cooperation, 1931-1933*

	Amount appropriated for fiscal year—		
	1931	1932	1933
For the prevention and suppression of forest fires and for the forest-taxation inquiry (secs. 1-3 of the Clarke-McNary law)	\$1, 700, 000	\$1, 775, 000	\$1, 661, 584
For the distribution of forest-planting stock to farmers (sec. 4 of the same law)	93, 000	95, 000	79, 000
For farm-forestry extension (sec. 5 of the law, administered by the office of cooperative extension work)	70, 000	74, 000	69, 850

The results of the work are summarized below, except those of the taxation study, which appear on page 30. Table 2 shows in detail the Federal, State and private funds disbursed by the States or expended under their supervision for the prevention and suppression of forest fires, and the Federal and State funds disbursed by the States for the production and distribution of planting stock.

TABLE 2.—Cooperative expenditures for fire protection and for the distribution of forest-planting stock under the Clarke-McNary Act, fiscal year 1932

State	For fire protection				For the distribution of forest planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Alabama	\$40,253.37	\$9,171.76	\$31,141.38	\$80,566.51	\$231.25	\$240.88	\$472.13
California	170,498.00	159,333.09	351,731.01	681,562.10	409.77	409.77	819.54
Colorado					1,927.50	1,927.50	3,855.00
Connecticut	14,008.00	68,246.43	3,446.30	85,700.73	2,000.00	2,503.25	4,503.25
Delaware	1,318.00	11,994.93		13,312.93	2,000.00	3,043.66	5,043.66
Florida	65,826.12	35,608.59	30,234.13	131,668.84	2,210.00	2,569.06	4,779.06
Georgia	57,689.97	22,712.06	34,977.91	115,379.94	2,000.00	3,736.07	5,736.07
Hawaii	466.00	1,524.04		1,990.04	3,400.00	18,746.89	22,146.89
Idaho	69,251.00	74,768.83	224,113.80	368,133.63	913.00	922.64	1,835.64
Indiana	7,560.00	10,270.61		17,830.61	3,637.71	12,563.59	16,201.30
Iowa					2,000.00	3,353.99	5,353.99
Kansas					2,000.00	2,532.00	4,532.00
Kentucky	18,780.00	18,780.01		37,560.01	1,785.00	1,997.34	3,782.34
Louisiana	51,810.00	62,710.85	33,195.92	147,716.77	2,175.81	2,197.75	4,373.56
Maine	54,732.00	169,673.52		224,405.52	868.49	868.47	1,736.96
Maryland	12,203.00	63,387.78	312.38	75,903.16	2,230.00	4,638.15	6,868.15
Massachusetts	34,991.25	70,153.90		105,145.15	3,150.00	4,829.92	7,979.92
Michigan	131,320.00	523,798.78		655,118.78	2,820.00	5,166.20	7,986.20
Minnesota	98,443.00	360,965.22	22,215.58	481,623.80			
Mississippi	18,734.53	17,296.24	1,438.30	37,469.07	428.36	428.38	856.74
Montana	30,145.00	11,563.76	49,763.91	91,472.67	2,250.00	3,442.95	5,692.95
Nebraska					3,880.00	8,552.62	12,432.62
Nevada	1,220.00	105.00	5,694.58	7,019.58			
New Hampshire	18,012.00	30,393.30	6,632.25	55,037.55	2,911.00	2,910.99	5,821.99
New Jersey	28,140.00	134,621.39		162,761.39	4,000.00	17,154.48	21,154.48
New Mexico	2,041.82	2,762.00	3,633.00	8,436.82			
New York	77,191.00	281,742.88	2,050.45	360,984.33	4,000.00	24,424.60	28,424.60
North Carolina	50,090.61	40,824.41	9,266.21	100,181.23	2,360.00	3,101.62	5,461.62
North Dakota					2,660.00	4,364.49	7,024.49
Ohio	7,491.00	10,787.06		18,278.06	3,290.00	14,560.36	17,850.36
Oklahoma	16,670.00	15,889.80	1,000.00	33,559.80	2,470.00	3,452.53	5,922.53
Oregon	104,092.00	44,157.81	132,623.72	280,873.53	2,000.00	2,310.04	4,310.04
Pennsylvania	54,314.00	371,995.79		426,309.79	4,000.00	16,439.51	20,439.51
Puerto Rico					2,940.00	6,900.83	9,840.83
Rhode Island	2,410.00	8,408.54		10,818.54			
South Carolina	28,978.83	16,433.60	18,167.77	63,580.20	1,759.23	1,759.21	3,518.44
South Dakota	1,125.00	1,214.01		2,339.01			
Tennessee	25,320.00	25,210.84	3,816.15	54,346.99	2,344.35	2,344.36	4,688.71
Texas	42,205.00	46,496.13	13,842.74	102,543.87			
Utah					1,300.00	1,300.00	2,600.00
Vermont	7,894.00	8,054.29	3,716.45	19,664.74	2,000.00	2,010.79	4,010.79
Virginia	35,730.00	46,197.08	6,039.12	87,966.20	2,160.01	2,741.45	4,901.46
Washington	111,513.00	94,606.57	89,645.34	295,764.91	2,000.00	2,000.00	4,000.00
West Virginia	31,348.00	42,870.72	15,246.53	89,465.25	2,150.00	7,464.62	9,614.62
Wisconsin	48,983.00	361,597.16		410,580.16	2,000.00	2,812.63	4,812.63
Wyoming					1,522.50	1,714.38	3,236.88
Administration and inspection	81,273.05			81,273.05	3,476.49		3,476.49
Total	1,654,101.55	3,276,328.78	1,093,944.93	6,024,375.26	93,660.47	204,437.97	298,098.44
Forest taxation and insurance study	60,764.70						
Cost of pine seed on hand June 30, 1932, subject to requisition by cooperating States					641.25		
Unexpended balance	160,133.75				698.28		
Total appropriation	1,775,000.00				95,000.00		

¹ Includes \$41,500 reserved from expenditure in compliance with the savings program of the Department of Agriculture.

COOPERATIVE PROTECTION OF STATE AND PRIVATE FOREST LANDS FROM FIRE

In the calendar year 1931 approximately 228,000,000 acres of State and private forest or potential forest lands were reported by the States as under some form of organized protection from fire. There was a slight gain over 1930, but not enough to show in the rounded-off amount reported, which was 55 per cent of the total forest area classed as needing protection.

Table 2 shows a total of \$4,370,274, State and private funds, spent by the States and private owners in cooperative forest-fire protection in the fiscal year 1932. In the fiscal years 1931, 1930, and 1929 the corresponding amounts were \$5,011,421, \$4,117,652, and \$3,042,333. Hitherto, at least, the depression has not substantially affected the provision made by most States for this work. While there was retrenchment in some cases, especially in the South, the region where the need is perhaps most pressing, nearly all the States have managed to keep their fire-protection organizations intact.

Cooperation in fire protection was initiated during the fiscal year with Nevada and Hawaii. This brought the number of cooperating States to 38.

The total area reported as burned by forest fires in the calendar year 1931 on lands protected by the States or the Forest Service was 6,378,000 acres (of which 2,254,000 acres are classed as not having a productive value), as against 5,809,000 acres in 1930; and on unprotected forest lands 45,200,000 acres, as against 46,457,000 acres in 1930. The data for the unprotected lands are too fragmentary and inexact to serve as more than rough estimates; but as they stand they indicate that 88 per cent of the area reported as burned over in the calendar year 1931 was unprotected land. Within protected units 4,124,000 acres of productive forest land were reported as burned over, or 1.24 per cent.

The number of fires reported for protected units for the calendar year 1931 was 61,854, in contrast to an average for the previous five years of 44,672.

COOPERATION WITH STATES IN TREE PLANTING

In the calendar year 1931 the planting of windbreaks, shelter belts, and wood lots by farmers continued at a rate comparable with other years. Over 25,000,000 young forest trees were distributed by the 38 cooperating States, Hawaii, and Puerto Rico. This provided planting stock for not less than 25,000 acres. The stock distributed is unsuitable for other use than forest planting and is sold with the understanding that it will be employed for that purpose only. Since the enactment of the Clarke-McNary law in 1924 nearly 157,000,000 trees have been distributed to farmers. Pennsylvania distributed in 1931 6,000,000 trees, and New York nearly 5,000,000. Other States that are approaching large-scale cooperative production are Ohio, Michigan, Indiana, Tennessee, Nebraska, and Wisconsin.

The expenditures of Federal and of State funds during the year are shown for each State in Table 2.

COOPERATION WITH STATES IN FARM-FORESTRY EXTENSION

During the year 32 States and 2 Territories cooperated with the Department of Agriculture under section 5 of the Clarke-McNary law, as a part of the broad extension programs of the State agricultural colleges. The Federal cooperation is administered by the Extension Service, with the assistance of the Forest Service. The management of the farm woods for increased returns, the establishment of young forests by the planting of idle farm lands to trees, and the teaching of forestry to rural school children through 4-H club activities are the leading projects in the State extension forestry programs. Last year assistance in woodland management was given on 9,534 farms; 7,057 farm-forest plantings and 4,676 windbreaks were established; and 7,877 junior forestry projects were completed by 4-H club members. Assistance was also provided on 11,404 farms in such other phases of forestry as estimating timber, marketing, fire protection, maple-sirup production, and wood preservation.

Field contacts with farmers are made by the State extension foresters who are the leaders of the projects and by county agricultural agents, with the assistance of local leaders, county forestry organizations, and other State groups interested in promoting the growing of timber on the farm.

NATIONAL FOREST ADMINISTRATION

The expenditures for national-forest administration, protection, improvement, reforestation, and extension, totaling \$32,749,860.09, are shown in detail on page 37.

The appropriations of Federal funds for the national-forest enterprise in the fiscal years 1931, 1932, and 1933 are shown in Table 3.

TABLE 3.—*Appropriations of Federal funds for the national-forest enterprise, 1931-1933*

Item	1931	1932	1933
General expenses of administration, protection, and improvement.....	\$7, 618, 460.00	\$7, 809, 880.00	\$7, 483, 824.00
Specifically for:			
Fire control.....	1, 420, 000.00	4, 410, 000.00	125, 000.00
Improvements, tree planting, land and resource surveys, and land adjustments.....	3, 210, 620.00	2, 866, 440.00	1, 371, 470.00
Land acquisition.....	2, 000, 000.00	2, 000, 000.00	200, 000.00
Roads and trails (construction and maintenance) needed primarily for forest protection and development.....	6, 671, 023.72	3, 496, 243.59	8, 227, 302.60
Highway construction and maintenance primarily to meet public needs, as a recognition of Federal responsibility created by ownership of untaxed lands.....	11, 000, 000.00	9, 500, 000.00	10, 905, 00.00

The second item in the 1932 column of Table 3 is greater by \$4,260,000 than the corresponding sums reported for 1932 in last year's report. This increase took place through a deficiency appropriation of \$4,260,000 to replenish funds drawn upon for fire-fighting expenditures in excess of the nominal amount appropriated in advance for this purpose. As has been explained in earlier reports, this is an established procedure, since the amount that will be required can not be foreseen and varies greatly from year to year. The 1933 amount of \$125,000 is less than the usual sum provided in advance, owing to a cut from \$50,000 to \$25,000 in the appropriation for aerial fire control.

The differences in other items between the 1932 and 1933 appropriations also call for explanation.

The decrease of \$326,056 in the first item represents a cut for all activities other than blister-rust-control work of \$367,391, partly offset by an increase of \$41,335 for that work, for which the total amount provided is \$236,335. The \$150,000 deficiency appropriation in 1932 for blister-rust-control work, referred to in last year's report, was taken over into the regular appropriation for 1933, and the amount was further increased. This put the work on a substantial basis as a continuing activity.

The decrease of \$1,494,970 in the third item comprises cuts of \$6,210 for land adjustments, \$95,800 for planting, \$53,400 for timber surveys and range reconnaissance, and \$1,339,560 for the construction of improvements.

The decrease of \$1,800,000 in the fourth item, land acquisition, wiped out the entire land-purchase program and simply provides for the maintenance of a part of the organization, which has been built up over a long period of years, to handle the continuing features of the work.

The increase of \$4,731,059.01 in the fifth item was caused by the appropriation of \$5,000,000 for forest improvements in the emergency relief and construction act of 1932, minus a decrease of \$268,940.99 in consequence of the smaller receipts from the national forests in 1932, as is shown on page 38. The sixth item's net increase of \$1,405,000 is the difference between the \$5,000,000 carried in the same emergency relief and construction act, for the construction of forest highways, and a cut of \$3,595,000 in the regular appropriation.

THE NATIONAL-FOREST PROPERTIES

The gross area of the national forests on June 30, 1932, was 186,215,256 acres, of which 24,854,565 acres was in ownerships other than that of the United States, making the net area 161,360,691 acres. During the year the gross area increased 963,674 acres and the net area 573,004 acres. Area recomputations based on better surveys and land data reduced the gross area 122,457 acres; eliminations by Presidential proclamation or Executive orders, 130,623 acres; eliminations by acts of Congress, 973 acres; and State selections under land-exchange agreements, 11,346 acres. On the other hand, presidential proclamations and Executive orders added 1,069,788 acres, acts of Congress 70,742 acres, and land exchanges 88,543 acres. Table 4 shows the changes in detail.

The Osceola and Green Mountain additions set up new national forests, by proclamation of the President. The Osceola, Green Mountain, and a part of the Ouachita areas were formerly purchase units within which lands were being

TABLE 4.—National-forest gross-area changes, fiscal year 1932

National forest	State	Additions	Eliminations
		<i>Acres</i>	<i>Acres</i>
Bitterroot.....	Montana.....	¹ 872	
Black Hills.....	Wyoming.....	¹ 950	
Cabinet.....	Montana.....	¹ 5, 121	
Cache.....	Idaho.....	² 19, 407	
Crater.....	Oregon.....		² 973
Custer.....	South Dakota.....		³ 2, 339
Deerlodge.....	Montana.....		⁴ 89, 313
Deschutes.....	Oregon.....	¹ 160	
Eldorado.....	California.....	¹ 660	
Green Mountain.....	Vermont.....	⁴ 102, 100	
Harney.....	South Dakota.....	¹ 746	³ 495
Do.....	Wyoming.....	¹ 347	
Helena.....	Montana.....	¹ 160	
Idaho.....	Idaho.....	² 51, 335	
Kootenai.....	Montana.....	¹ 160	
Lolo.....	do.....	¹ 10, 055	
Ocala.....	Florida.....	⁴ 10, 801	
Ochoco.....	Oregon.....	¹ 758	
Olympic.....	Washington.....		³ 2, 473
Osceola.....	Florida.....	⁴ 161, 813	
Ouachita.....	Arkansas.....	⁴ 503, 585	
Do.....	Oklahoma.....	⁴ 291, 489	
Sante Fe.....	New Mexico.....		⁴ 26, 028
Shasta.....	California.....	¹ 65, 308	
Siuslaw.....	Oregon.....		⁴ 15, 225
Snoqualmie.....	Washington.....	¹ 209	³ 6, 039
Tahoe.....	California.....	¹ 1, 467	
Tongass.....	Alaska.....		⁴ 50
Wenatchee.....	Washington.....	¹ 1, 490	
Whitman.....	Oregon.....	¹ 80	
Total.....		1, 229, 073	142, 942

¹ Private lands acquired through exchange.² Made under acts of Congress.³ Made through State selections of exchange lands.⁴ Made by presidential proclamation or Executive order.

acquired through the National Forest Reservation Commission. The Santa Fe elimination transferred jurisdiction over the Bandelier National Monument to the Department of the Interior, and the area eliminated from the Crater Forest was added to the Crater Lake National Park. The area eliminated from the Deerlodge Forest was one in which all national-forest lands had passed to private ownership through exchanges, and the Siuslaw elimination embraced lands acquired through exchanges by the State of Oregon. The eliminations from the Tongass were to permit entries under the trade and manufacturing act. To reduce the cost of administration, the lands comprising the Jefferson, Beartooth, Madison, and Missoula National Forests, in Montana, were transferred to other national forests; the Datil National Forest, in New Mexico, was divided between the Gila and Cibola National Forests; and the Toiyabe National Forest, in Nevada, was consolidated with the Nevada.

To avoid confusion in names, the Shenandoah National Forest, in Virginia, was redesignated as the George Washington, and the Manzano, in New Mexico, as the Cibola; the Colorado, in Colorado, became the Roosevelt, the California, in California, the Mendocino, and the Crater, in Oregon, the Rogue River.

LAND ACQUISITIONS THROUGH EXCHANGE

Within the national forests are 24,854,565 acres of lands in other than Federal ownership, of which possibly 40 or 50 per cent may be adapted to permanent private ownership and management. The capacity of the remainder permanently to produce sufficient money income to afford the private owner a return on his investment after paying taxes and protection costs is highly questionable, and reversion of destructively exploited lands to State or county ownership through tax delinquency is increasing. The same situation exists with respect to many millions of acres adjoining national forests. Under present conditions

these lands markedly increase the difficulty and cost of protecting and administering the public forests. Their utilization frequently creates serious fire hazards, they control important rights of way, they are subject to forms of use and occupancy incompatible with proper plans of national-forest land use, and their diverse ownership militates against the principles of resource management which would yield the highest economic and social returns.

The desirability of consolidating public ownership within the national forests has been so evident to Congress that in the period since 1908, when the first exchange act was passed, 56 laws of more or less general application have been enacted, and 13 authorizing specific exchanges. The provisions of these laws have been conservatively applied. No land of appreciable public value is relinquished to private ownership. Appraisals of offered lands have been held to the minimum prices justified by local commercial transactions, the equitable or moral rights of persons using selected lands under permit have been safeguarded, and the effect of proposed exchanges upon taxation and on the share of national-forest receipts going to the counties is invariably considered. Not only are all exchanges, other than those with States, advertised (as is required by law); all important ones are discussed in advance with the proper county officials, whose valid objections, if any, always receive major attention. Had only betterment of the public properties received consideration, progress in national-forest consolidation through exchanges would have been more rapid.

Proposals that the program of cash purchases under the Weeks and Clarke-McNary laws be extended to the Western States are made with increasing frequency, but the large areas of land and bodies of stumpage under Federal ownership suggest that national-forest consolidation in the West should take place primarily through exchange rather than purchase. As earlier reports have pointed out, the use for this purpose of unreserved and unappropriated public lands could be made to serve both the fixed policy of the United States to facilitate the passage of the unreserved public lands to private or State ownership and the policy of permanent national forests.

The fourth exchange with the State of Michigan was consummated during the year, under the act of July 31, 1912 (37 Stat. 214). The State reconveyed 4,922.22 acres situated within national forests and selected in lieu thereof 4,266.75 acres of unreserved public lands, widely distributed throughout the State. Additional exchanges with the States of Colorado, Montana, and South Dakota continued to receive consideration. Amendments to the constitutions and enabling acts of Minnesota and New Mexico will again be submitted to the voters this fall and, if adopted, will authorize desirable exchanges.

During the calendar year 1931 reconveyances to the United States of 98,913 acres of private lands in exchange for 100,081 acres of national-forest land and 86,556,000 board feet of national-forest stumpage, valued at \$279,831, added a net 98,832 acres to the forests. The Secretary of Agriculture approved and referred to the Secretary of the Interior for further action 112 new offers of 143,452 acres of privately owned land in exchange for 29,471 acres of national-forest land and \$323,882 worth of stumpage. In all, to December 31, 1931, 830 land-exchange cases had been consummated. Through them the United States has acquired 1,205,100 acres of land, valued at \$4,773,519, in exchange for 390,415 acres of national-forest land, valued at \$1,795,099, and 58,268,000 board feet of national-forest stumpage, valued at \$2,377,820. Besides the net gain of 814,685 acres in national-forest area the volume of stumpage on the acquired lands is much greater than that surrendered.

LAND ACQUISITION THROUGH PURCHASE

Title was taken under the Weeks law, as amended by the Clarke-McNary law, on 362,075 acres, at a cost of \$1,210,232.12. Purchases totaling 83,086 acres and creating a total obligation of \$206,458.45 were approved by the National Forest Reservation Commission. The average price was \$2.48 per acre for the lands approved for purchase and \$3.34 per acre for the lands actually acquired, as compared with a previous average of \$4.66 for all lands acquired. At the close of the year the average cost of all lands fully acquired, not including overhead, was \$4.55 per acre, the total \$19,899,401.15, and the area 4,369,456 acres, distributed by States as shown in Table 5.

TABLE 5.—*Acreage of timberland acquired in the fiscal year 1932 and total acquired to July 1, 1932*

State	Acquired in 1932	Average price per acre 1932	Total acquired up to July, 1932	State	Acquired in 1932	Average price per acre 1932	Total acquired up to July, 1932
	<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>		<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>
Alabama.....	6, 418	5. 78	112, 165	Oklahoma.....	6, 482	1. 68	54, 579
Arkansas.....	26, 555	3. 15	309, 610	Pennsylvania.....	19, 273	6. 93	369, 276
Florida.....	31, 302	5. 08	229, 262	South Carolina.....	653	3. 79	47, 473
Georgia.....	60, 774	3. 69	330, 263	Tennessee.....	7, 884	4. 33	387, 509
Louisiana.....	8, 616	4. 94	75, 598	Vermont.....	1, 842	15. 30	1, 842
Maine.....			33, 482	Virginia.....	1, 516	5. 76	602, 752
Michigan.....	91, 277	2. 35	303, 250	West Virginia.....	9, 268	3. 61	327, 234
Minnesota.....	12, 645	1. 84	127, 705	Wisconsin.....	50, 978	1. 59	165, 977
Mississippi.....							
New Hampshire.....	12, 210	2. 97	495, 001	Total.....	362, 075	3. 34	4, 369, 456
North Carolina.....	14, 382	3. 97	396, 428				

During the year the National Forest Reservation Commission expressed its concurrence in the establishment of three new purchase areas in Wisconsin and the enlargement of an existing area in the same State. The new units are the Chequamegon, with 361,497 acres, in Ashland and Sawyer Counties; the Mont-deaux, with 171,832 acres, in Taylor County; and the Oconto, with 203,418 acres, in Oconto and Langlade Counties. The enlargement added 68,000 acres to the Oneida purchase area, in Forest and Vilas Counties. Although prospective appropriations offered no promise for the early initiation of land purchases within the new areas, their designation, by clarifying and defining the land-purchase program of the Federal Government in Wisconsin, facilitated the formulation of correlated State, county, and private programs of future forest-land management and use, and thus was urgently desirable. Practically all interested official and private agencies within the State advocated and supported the action taken.

Large acreages of land within the Cumberland area in Kentucky and the Mesaba area in Minnesota had been offered for sale, cruised, appraised, and covered by options at acceptable valuations, but none of these lands could be acquired for lack of available funds. In many of the other established areas also, large acreages under option at satisfactory prices were passed over. At no time since the initiation of the Weeks law purchase work have desirable lands been purchasable so readily or at such low prices as at present, and probably at no time in the past have the disbursements in payment contributed in so great a degree to the relief of local financial stress.

The Weeks law has been on the statute books 21 years; the supplementary Clarke-McNary law, 8 years. Although neither law is limited geographically their application has been confined as a matter of policy to that part of the United States east of the Great Plains. Even so, they relate to three-fourths of the country's forest-land area, to the regions of greatest population, to the majority of the streams of leading importance for navigation and municipal water supply or of leading menace as sources of destructive floods and sedimentation, to the States containing the bulk of the wood-using industries, and to most of the large cities to which facilities for outdoor recreation are most essential; in other words, to that part of the Nation in which a sound program and plan of land use is most vitally necessary.

Within the area involved processes inimical to the general welfare are expanding rather than diminishing in scope. Soil depletion due to long-continued cropping or erosion, or both, gradually is enlarging the area of submarginal farm land. Fire and indiscriminate logging are steadily bringing deterioration in the power to grow timber. Such restorative processes as have been initiated fail to offset the retrogression. Many private owners are relinquishing their lands to the public rather than pay taxes on them.

Except where national interests are predominantly involved, this situation should so far as is possible be remedied by the States and counties within which it exists. Some few States are financially able to meet it. Some other States are prepared to meet it partly. But many of the States in which the need for remedial action is most acute are least prepared to assume new financial responsibilities. The very process of land denudation through logging and fire, or of reversion to public ownership through tax delinquency, by reducing the tax base diminishes the power to give the lands public care. The Nation can not regard with indifference the wholesale retrogression of large sections

of the country and the going to waste of resources important to other regions. It is believed that an adequate national program of forestry should include provision for more extensive purchases of lands under the provisions of the Weeks and Clarke-McNary laws than have hitherto been contemplated, and for their permanent Federal administration as national forests.

The maximum Federal program formulated to date contemplates for all the eastern half of the United States an ultimate national-forest area of approximately 16,000,000 acres, or 4.3 per cent of the total forest area. It is a matter of public concern that progress in carrying out even this program has been halted because of the depression. Within the 37 national-forest purchase units already established more than 6,000,000 acres continue in private ownership notwithstanding their integral relationship to the lands already acquired. Their cost, hitherto estimated at approximately \$31,000,000, would undoubtedly under prevailing circumstances be substantially less. Their early purchase would liquidate capital now unproductively invested in them and would aid local financial recovery. An early resumption of appropriations for the acquisition of forest lands under the Weeks and Clarke-McNary laws is urged.

SPECIAL USES

At the close of the calendar year 1931, 36,457 special-use permits were in effect, as against 35,250 at the close of 1930; 17,161 were free, and 19,296 were subject to annual rental charges. The receipts, \$282,799.35, were less by \$18,177.14 than those for 1930. Some of the decrease probably was due to delayed payments. A bill to authorize a maximum area of 80 acres for term permits passed the Senate during the recent session of Congress, and is now before the House of Representatives. The enactment of this bill would greatly facilitate both recreational and other special uses, and would promote higher standards of construction and improvement, with an increase of public services, public revenues, and taxable values.

CLAIMS AND SETTLEMENT

During the calendar year 1931, reports were submitted on 98 applications for homestead patents, 83 favorable and 15 unfavorable, and on 119 applications for mineral patents, of which 58 were favorable and 61 unfavorable. An increase in unfavorable reports resulted largely from efforts in California evidently made to acquire under the mineral land laws national-forest lands with large surface values for purposes wholly unrelated to mineral development. The need for amendment of the mining laws to prevent their misuse and abuse continues to be acute.

COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

By act of Congress 973 acres, known as the Anna Creek area, were transferred from the Crater National Forest to the Crater Lake National Park, and by Executive order the Bandelier National Monument, comprising 26,026 acres, was eliminated from the Santa Fe National Forest and placed under the National Park Service. The remaining specific proposals for transfers of national-forest lands to national parks mentioned in last year's report received extended and detailed consideration. All involve lands having large material as well as inspirational values, and the course taken will markedly influence the future of local communities and counties. While national interests should not be subordinated to local, sound land-use and resource planning require that in each case the relative importance of the various public values involved, the degree to which their coordinated development is practicable, and the qualifications of the area for meeting the high quality standards set up for the national parks, all be carefully weighed and considered together, to the end that the course which will be in the best permanent public interest may be made clear.

NORTHERN PACIFIC LAND GRANT ADJUDICATION

During the year the Federal court of the eastern district of the State of Washington gave preliminary consideration to the action initiated under the provisions of the act of June 25, 1929, to adjudicate the equities established by the Northern Pacific Railway Co. under the land grant act of July 2, 1864, the resolution of May 31, 1870, and other supplementary laws. The Government's interests were represented by the Department of Justice, with which the Forest Service cooperated extensively in field determinations and record checks of land valuations, classifications, transfers, status, and other matters bearing upon the case at issue.

PROTECTION FROM FIRE

The calendar year 1931 will probably long remain the yardstick for measuring severe fire years, not indeed from the standpoint of losses, but from that of danger and conditions which make the task of control most difficult. As was reported last year, the spring season was of unprecedented severity. The snowfall in the winter of 1930-31 had been extremely light, especially in the Northwest; and this added to the cumulative moisture deficiency of a series of preceding drought years. In 1931 the dryness in northern California, eastern Washington and Oregon, all of Idaho and Montana, and northern Colorado, South Dakota, and Wyoming was the worst in two decades. In the Southeast the cumulative effects of drought were evident in dried-out swamps, which burned freely and poured out such huge volumes of smoke that the detection organization was crippled. This condition continued in the Southeast into the spring of 1932.

Fortunately the fire season in the West was shorter than that of 1929; the hurricane winds of 1910 did not recur and there was no such concentration of lightning fires as marked 1926; but incendiary fires were more numerous and more cleverly located, and the unexampled dryness of the forest fuel often made the usual methods of protection entirely ineffective. Dry weather produces its effect in several ways. Through cyclic drought, diminished precipitation over a succession of years lowers the underground supplies of water, diminishing stream flow, drying up springs, and affecting the vegetation; seasonal drought accentuates these conditions, making the whole forest highly inflammable; and days of exceptionally low atmospheric humidity bring the forest fuel to a dryness that makes it like tinder and gives fire an almost explosive character. The 1931 fire season owed most of its severity to the fact that exceptional cyclic and "dry day" conditions were combined.

The Weather Bureau records for Spokane afford evidence that, in the most dangerous fire section of the country, in every year but 1927 from 1914 to and including 1931, the mean annual precipitation fell below normal; and the accumulated deficiency at the close of the period was 58.97 inches. By mid-July of 1931 the usual summer drought, added to the cumulative effect of the cyclic drought, had brought the forests in most of the West to a powder-keg state. Road-construction crews, which ordinarily find the soil moist at a depth from 1 to 2 feet, worked in clouds of dust in excavating at a depth of 4 feet and more. In forests in the northern Rocky Mountain region the duff moisture content, which is rated as extremely dangerous at 10 per cent, dropped to 4 per cent for the first time on record, and for as many as 27 days all told. In the bad season of 1929 the lowest duff moisture content was 5 per cent, and that on only one day; and in the 1926 season, with its heavy loss in area burned, the minimum was 7 per cent, and that only twice. Burning conditions which were truly explosive were the result.

The Priest River fire, in northern Idaho, furnishes an example. It started outside the forest boundary at 11 a. m. on August 3, and "crowned" immediately. Within an hour it was 2 miles long and 1 mile wide, and in the early afternoon was racing on a front of 5 miles, with a length of 15 miles. By nightfall, when the wind dropped, it had destroyed 34 ranches, blocked two highways with burning timber, and trapped a hundred people. By midnight 700 men were attacking it, and by noon of the next day 1,500 men were on the fire line. Within five days the tremendous job of building 90 miles of line around this fire, in dense standing and down timber and rugged mountain country, along steep slopes, was completed; but six weeks of "mopping up" and patrol were required before the fire was considered safe.

The Governors of Montana and Idaho issued proclamations relating to the urgency of the fire situation. The Governor of Idaho declared martial law in a number of counties in southern Idaho, and called out the National Guard to enforce his declaration. Travel on roads through the national forests in these counties was allowed only under written permit from the adjutant general of the State. National Guard men were stationed at entrance roads and patrolled critical forest areas. Never before has martial law been declared because of the seriousness of fire conditions in national-forest territory. In South Dakota the aid of Federal troops was effective in blocking incendiaries, who were extremely active there.

The area burned over for all national forests did not very greatly exceed the annual average of the preceding five years, which included light, moderate, and critical seasons. Comparing 1931 with the two most critical years of the pre-

eding 5-year period, the area burned within national-forest boundaries was less by one-third; and it was less by three-fourths than the area burned over in 1919.

The Forest Service is much better prepared to meet critical fire situations than it was 10 years, or even 5 years, ago. While the expenditures in 1931 were greater than in any previous year, they must be set over against the results obtained in the face of very great difficulties. Their future magnitude will depend partly on how long the dry cycle holds. At least a temporary break in it has taken place in 1932, and the fire-fighting expenditures for the present season have been, to the date of this report (September 1), but approximately 15 per cent of the corresponding amount for the previous year.

In 1931 twenty Forest Service employees were killed while on fire-suppression work. Their names follow:

Herbert Harney.	Ed Murphy.
Nolan Warner.	Carl A. Obermeyer.
James Taylor.	V. Leroy West.
Herbert Novotny.	J. Kane.
Frank Williamson.	Ira Hayden.
Fed Bierchen.	Vernon L. Cresson.
Hjalmer Gudmundsen.	Frank E. Jones.
Charles Allen.	Jesse B. Paige.
Raymond Helm.	Chas. E. Bramhill.
John Moss.	Louis Pariseau.

Table 6 presents the fire record of the year in the usual detail. The excess of more than 1,500 in the number of man-caused fires in 1931 over the 5-year average is a source of very great concern, particularly in view of the prevention efforts made by both Federal and private agencies. It is true that the number of fires is a rough index of inflammability. Nevertheless, this and the increased use of the forests by recreation seekers and others do not justify indifference to the dangerous trend, especially since incendiarism has markedly increased. Renewed efforts, with the invaluable help of prominent citizens and organizations, are being made to meet this situation. In Idaho and Montana groups of citizens, with the indorsement and aid of the State governors, have pledged themselves, somewhat in the spirit of the old vigilante committees, to exert their influence for the reduction of man-caused fires, and especially to discountenance and try to stamp out incendiarism.

TABLE 6.—Comparison of fires on national forests, calendar years 1931, 1930, and 5-year average, 1927-1931

	Number of fires			Percentage of total		
	1931	1930	Average, 1927-1931	1931	1930	Average, 1927-1931
Class:						
Burns of 0.25 acre or less.....	4,676	4,653	4,179	55.23	55.47	56.60
Burns of between 0.25 and 10 acres.....	2,258	2,246	1,980	26.67	26.78	26.82
Burns of 10 acres and over.....	1,532	1,489	1,224	18.10	17.75	16.58
Total.....	8,466	8,388	7,383	100.00	100.00	100.00
Cause:						
Railroads.....	166	172	241	1.96	2.05	3.27
Lightning.....	2,917	4,032	3,344	34.45	48.07	45.29
Incendiarism.....	1,444	1,288	921	17.06	15.36	12.48
Débris burning.....	449	278	285	5.30	3.31	3.86
Lumbering.....	92	118	108	1.09	1.41	1.46
Camp fires.....	992	715	744	11.72	8.52	10.08
Smokers.....	1,872	1,422	1,389	22.11	16.95	18.81
Miscellaneous.....	534	363	351	6.31	4.33	4.75
Total.....	8,466	8,388	7,383	100.00	100.00	100.00
Calendar year			Total area of national-forest land burned over	Total damage of national-forest land burned over	Total cost of fighting fires exclusive of time of forest officers	
			<i>Acres</i>	<i>Dollars</i>	<i>Dollars</i>	
1931.....			532,761	3,652,248	4,049,466	
1930.....			137,944	348,890	1,192,139	
5-year average, 1927-1931.....			407,832	1,894,350	2,056,892	

The report for 1930 described in some detail what was being done to adapt radio to forest-protection needs. This project is now close to completion. The national forests of the Northwest have been equipped this year with 160 radio sets of the types developed by the Forest Service. Prior to the development of these instruments no satisfactory radio outfit was light enough to be carried in the back pack of a fire chaser. The small featherweight unit weighs 10 pounds complete. It receives voice and transmits code. The semiportable type, which transmits as well as receives voice, weighs from 25 to 40 pounds, the weight depending on the number of batteries. There is a probability that a third type, which also will transmit as well as receive voice but which will be lighter than the semiportable design in use this season, will be found to be adaptable to rough usage in mountainous, timbered country. The central station mentioned in the last report is no longer required.

The greater use of airplanes in the transportation of men and supplies to areas poorly equipped with roads is particularly significant. This development was revolutionary. It will substantially modify road-development programs for back-country areas. Airplanes were used last year to get men and supplies to inaccessible areas under normal conditions as well as in emergencies; they increased the mobility of the key men of the fire-control forces; and they were used also to transport out badly injured men. Several regions are now giving the construction of landing fields high priority in their improvement plans.

The cumulative experience gained during the extended dry cycle, with its varying degrees of intensity, makes clear that the best way to reduce the fire damage and the costs of suppression, which together make up the cost of fire, is through preparedness aimed, first, at reducing the number of fires, and secondly, at preventing those which do occur from becoming large. In 1931 only 1 fire out of every 24 was not corralled during the first period of attack; but the total of fire-suppression expenditures plus losses on the relatively few not so corralled was some three and a half times greater than for all the rest. Progress in 1931 in furthering the program of increased preparedness included more training, more guards, more transportation and communication facilities, more equipment and shelter for guards, greater skill in executive management, and many other fundamentals of effective fire control. This program continues to be of the utmost importance.

PROTECTION FROM TREE DISEASES AND INSECTS

The white-pine blister rust is the most serious tree disease that threatens the timber resources of the national forests. It has spread in the commercial range of the western white pine, in northern Idaho and western Montana, even faster than was anticipated, and is a grave danger to the future prosperity of that region, which is largely dependent on the logging and manufacturing of white pine. It attacks trees of all sizes, but the smaller the tree the more certain is its early death.

The discovery of the widespread distribution of this imported pest led to a reorganization of the work of destroying the wild currants and gooseberries within and near stands of pine. These shrubs are the alternate hosts of the disease, which can not pass from pine tree to pine tree but must spend part of its life cycle in the leaf of a plant of the genus *Ribes*. The center of the work of destroying *Ribes* was shifted into the more accessible stands of white pine, including merchantable timber, young stands, and plantations, on the St. Joe National Forest, where infection had been found on both pines and wild currants. The cooperation of the Bureau of Plant Industry, which conducts the Federal activities against this disease outside of the national forests, was extremely helpful, and assured the best correlation of the efforts of private owners, State authorities, and Federal agencies.

Insects, mostly bark beetles, appear to have found the dry years of 1930 and 1931 favorable in many localities. The increase in the destructiveness of the western pine beetle in California, mentioned in last year's report as a probability, proved to be very serious. Control work was done in cooperation with the owners of intermingled pine timber in the northern part of the State. Work was also done on and near a large sale area on the Sierra National Forest, where the losses were heavy both in the virgin forest and in seed trees left on cut-over areas. The exceptionally warm fall led to the maturing and the emergence of part of a third generation of beetles in this vicinity, making it necessary to cover some areas twice. In central Oregon, control work against the same beetle was conducted in valuable pine forests, with cooperation from the owners of adjacent and intermingled timber who wished to protect their own property; and a relatively small area of national-forest land adjacent to

the Crater Lake National Park was cleaned of tree-destroying beetles, as part of a cooperative project with the National Park Service.

It was found that the epidemic of the spruce bud worm in the Douglas fir stands on the Shoshone National Forest in Wyoming had subsided, but that many of the trees, weakened by the loss of most of their needles, had been attacked by the Douglas fir bark beetle, an insect which rarely causes large losses. An exceptionally well-organized and well-led crew cut and burned these infested trees, working in the snow into late December. It is too soon to speak confidently of the complete success of this work, but a very large reduction in the losses in this timber, much of it in sight from the road to the eastern entrance to the Yellowstone National Park, is assured.

Epidemics of the mountain pine beetle were fought in valuable white pine stands in Idaho and Montana; and also in some lodgepole pine stands in Utah, southern Wyoming, and southern Idaho, to protect timber supplies needed by railroads and local agricultural communities.

So far as possible, insect epidemics on the national forests are checked in their incipency. A relatively small outbreak of the Black Hills beetle near the South Dakota-Wyoming boundary was combated by giving the wood of the infested trees to local settlers, who cut and peeled the trees at the proper season. Trees which could not be given away were treated by a trained crew. This infestation was considered especially dangerous. The beetle killed over a billion board feet of timber in the Black Hills region about 25 years ago.

TIMBER

The year was one of decreasing activity in the lumber industry throughout the country. The cut of national-forest timber under sales fell from 1,052,16,000 board feet in the fiscal year 1931 to 544,560,000 board feet. This 48 per cent reduction was in about the same ratio as the decrease for the whole country; and, like it, was relatively greater during the latter half of the year. Many mills which are partly or wholly dependent on national-forest timber for their log supply did not attempt to operate. Others worked only part time.

Lumber companies, whether purchasers of national-forest timber or not, were adjusting their output to the lessened market and reducing their inventories of manufactured goods. These tendencies were encouraged by the Forest Service. In accordance with its policy for eight years, no offerings of timber for new lumber-manufacturing plants were made. Nothing resembling "distress selling" of national-forest stumpage occurred. Except for small amounts for local use, new contracts were made only with companies which have no suitable timber of their own or whose holdings are so intermingled with Government lands that both should be cut in a single operation. The amount of timber sold was 259,264,000 board feet, less than half of the total amount cut under new and old contracts combined.

Further, every effort was made to encourage holders of long-term contracts to refrain from operating during a period when overproduction was bad from a national viewpoint and harmful for many lumber manufacturers. Extensions of time for the completion of the cutting of entire sales or of specified amounts were given liberally. No one had to log in order to hold a timber contract on a national forest, or in order to avoid a prospective claim for damages due to failure to operate at the rate expected when the contract was made.

In a number of instances, unemployment-relief organizations cut wood on the national forests for sale or for distribution to those who lacked funds to buy fuel. Careful selection of the trees to be cut assured the improvement of the forest as a growing crop, and the idle were given work. Many residents within and near the national forests obtained timber or wood for their own needs, utilizing time which was available because of lack of opportunities for seasonal or temporary wage earning. These uses of timber were stimulated by the progress made in the construction of roads passable for light motor trucks, so that farmers and others could reach the timbered areas with relatively rapid transportation. There is room for a vast amount of cutting on the national forests, with a view to improving the growing conditions and increasing the quantity and value of the timber crop.

While the year closed without evidence of a revival in demand for national-forest timber, the indications seem to suggest that the processes of readjustment in the lumber industry may be well along, so far as meeting the immediate situation is concerned; and that in consequence a spirit of hopefulness is influencing many lumbermen to begin planning once more for future logging.

The national-forest timber-sale business for the calendar year 1931 is summarized in Tables 7 and 8.

TABLE 7.—Quantity and value of national-forest timber cut under sales, calendar year 1931

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alaska.....	23, 970, 000		23, 970, 000	40, 917		40, 917
Arizona.....	69, 339, 000	202, 000	69, 541, 000	167, 117	197	167, 314
Arkansas.....	6, 152, 000	228, 000	6, 380, 000	33, 685	228	33, 913
California.....	179, 514, 000	1, 652, 000	181, 166, 000	507, 843	1, 067	508, 910
Colorado.....	37, 659, 000	795, 000	38, 454, 000	89, 005	823	89, 828
Florida.....	5, 100, 000		5, 100, 000	25, 422		25, 422
Idaho.....	64, 709, 000	4, 577, 000	69, 286, 000	257, 768	4, 113	261, 881
Louisiana.....	608, 000		608, 000	243		243
Michigan.....	848, 000		848, 000	1, 670		1, 670
Minnesota.....	12, 888, 000		12, 888, 000	26, 419		26, 419
Montana.....	18, 981, 000	4, 690, 000	23, 671, 000	59, 127	5, 163	64, 290
Nebraska.....	6, 000		6, 000	31		31
Nevada.....	747, 000	248, 000	995, 000	966	224	1, 190
New Hampshire.....	5, 668, 000		5, 668, 000	22, 075		22, 075
New Mexico.....	12, 985, 000	1, 008, 000	13, 993, 000	26, 186	1, 004	27, 190
North Carolina.....	5, 138, 000		5, 138, 000	14, 270		14, 270
Oklahoma.....		2, 000	2, 000		2	2
Oregon.....	87, 710, 000	2, 232, 000	89, 942, 000	195, 444	1, 520	196, 964
Pennsylvania.....	4, 208, 000		4, 208, 000	6, 550		6, 550
South Dakota.....	22, 887, 000	306, 000	23, 193, 000	76, 063	319	76, 382
Tennessee.....	4, 718, 000		4, 718, 000	11, 323		11, 323
Utah.....	6, 624, 000	1, 506, 000	8, 130, 000	15, 235	1, 576	16, 811
Virginia.....	8, 643, 000		8, 643, 000	11, 169		11, 169
Washington.....	159, 261, 000	340, 000	159, 601, 000	326, 119	204	326, 323
West Virginia.....	84, 000		84, 000	324		324
Wisconsin.....	64, 000		64, 000	32		32
Wyoming.....	36, 175, 000	1, 344, 000	37, 519, 000	95, 329	1, 217	96, 546
Total, 1931.....	774, 686, 000	19, 130, 000	793, 816, 000	2, 010, 332	17, 657	2, 027, 989
Total, 1930.....	1, 237, 136, 000	17, 827, 000	1, 254, 963, 000	3, 599, 039	16, 959	3, 615, 998

¹ In addition, minor products not convertible into board feet were cut, value \$11,350.

² In addition, minor products not convertible into board feet were cut, value \$22,142.

TABLE 8.—Quantity and value of national-forest timber sold, calendar year 1931

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alaska.....	8, 858, 000		8, 858, 000	13, 681		13, 681
Arizona.....	106, 641, 000	268, 000	106, 909, 000	399, 118	273	399, 391
Arkansas.....	5, 816, 000	247, 000	6, 063, 000	42, 202	247	42, 449
California.....	159, 307, 000	1, 526, 000	160, 833, 000	423, 558	1, 013	424, 571
Colorado.....	14, 930, 000	932, 000	15, 862, 000	32, 788	960	33, 748
Florida.....	4, 914, 000		4, 914, 000	15, 635		15, 635
Idaho.....	114, 740, 000	6, 088, 000	120, 828, 000	499, 426	5, 084	504, 510
Louisiana.....	854, 000		854, 000	342		342
Michigan.....	1, 806, 000		1, 806, 000	2, 779		2, 779
Minnesota.....	2, 688, 000		2, 688, 000	4, 638		4, 638
Montana.....	9, 950, 000	4, 352, 000	14, 302, 000	20, 720	4, 694	25, 414
Nebraska.....	5, 000		5, 000	12		12
Nevada.....	568, 000	228, 000	796, 000	664	209	873
New Hampshire.....	7, 184, 000		7, 184, 000	33, 961		33, 961
New Mexico.....	13, 636, 000	1, 074, 000	14, 710, 000	27, 479	1, 080	28, 559
North Carolina.....	4, 492, 000		4, 492, 000	10, 815		10, 815
Oklahoma.....		2, 000	2, 000		2	2
Oregon.....	46, 851, 000	2, 322, 000	49, 173, 000	113, 901	1, 601	115, 502
Pennsylvania.....	1, 769, 000		1, 769, 000	4, 862		4, 862
South Dakota.....	9, 120, 000	308, 000	9, 428, 000	30, 534	340	30, 874
Tennessee.....	5, 370, 000		5, 370, 000	9, 690		9, 690
Utah.....	4, 012, 000	1, 626, 000	5, 638, 000	7, 874	1, 692	9, 566
Virginia.....	4, 743, 000	1, 000	4, 744, 000	5, 672	1	5, 673
Washington.....	47, 764, 000	354, 000	48, 118, 000	65, 997	225	66, 222
West Virginia.....	41, 000		41, 000	235		235
Wisconsin.....	201, 000		201, 000	186		186
Wyoming.....	8, 591, 000	1, 127, 000	9, 718, 000	17, 017	1, 007	18, 024
Total, 1931.....	584, 851, 000	20, 455, 000	605, 306, 000	1, 783, 786	18, 428	1, 802, 214
Total, 1930.....	3, 353, 295, 000	17, 122, 000	3, 370, 417, 000	9, 760, 599	16, 022	9, 776, 621

¹ In addition, minor products not convertible into board feet were sold, value \$19,564.

² In addition, minor products not convertible into board feet were sold, value \$41,704.

PLANTING

The reforestation of national-forest lands through planting does not readily lend itself to sudden expansion or contraction. It calls for careful advance planning and orderly execution through a term of years. Since the national forests need this form of reforestation on a scale far beyond anything possible with the funds hitherto provided, the scope of the program must be planned in accordance with the appropriations likely to be available. The individual projects to be programmed must then be selected, on the basis of their relative importance and urgency. The next step is to decide what kinds and amounts of planting stock will be needed, for each project. This sets up a nursery-production program. It must of course be in adjustment with the capacity of the nurseries. To enlarge their area ordinarily requires at least one or two years. To obtain the necessary seed supplies for planting in them also calls for planning ahead, since with some species abundant seed production usually takes place only at intervals of several years. The actual growing of the stock in the nursery requires from 1 or 2 to 4 years, depending on the species, the growing conditions, and the character of the site to be reforested. When the stock is finally produced, therefore, it represents an accumulated investment, which is wasted if field planting does not follow promptly; for once ready the stock soon grows too large for successful use. The cost of producing it takes up from one-fourth to one-half the entire cost of the plantations.

Congress recognized this general situation in 1930 by specifically authorizing the Forest Service to proceed with preparations for planting on an expanding scale as set up by legislative authorization of later appropriations rising from \$250,000 in the fiscal year 1932 to \$400,000 in 1934 and thereafter. The 1931 appropriation was \$225,000, as against \$210,000 for each of the two preceding years. For 1932 \$250,000 was appropriated, in accordance with the authorization. The appropriation for 1933, however, was reduced to \$154,200.

Nursery capacity has been gradually increased, chiefly to supply trees for planting on national forests east of the Great Plains. Out of a total of about 100,000 acres on all national forests needing to be planted, 500,000 acres are in the Lake States and 180,000 acres are in the East and South. Most of these lands have been purchased under the Weeks law and the Clarke-McNary law, for watershed protection and timber production. The restoration of a forest cover on areas devastated or burned before they were acquired by the United States is essential for the accomplishment of the purposes for which the lands were bought.

As a result of the gradual increase in the funds available, a larger area was planted during the fiscal year than ever before. It included over 8,000 acres in the Huron National Forest, in Michigan, where the total is now 40,000 acres, with 140,000 acres remaining to be planted there—about a 15-year task, at last year's rate. On the Pike National Forest, in Colorado, planting was completed on an area of about 7,000 acres on a watershed important for irrigation but largely devastated by cutting and fire a half century ago, before the national forests were created. The first output of trees from the nursery at Russellville, Ark., was used to plant about 700 acres of old fields on the Ozark National Forest. A beginning was made on the Oneida purchase unit, in Wisconsin, and about 1,200 acres were reforested on the Moquah purchase unit, in the same State. Adherence to the fiscal program of the Knutson-Andenberg Act of 1930 is requisite for continuance of the field planting on the scale corresponding to the present nursery capacity.

Power machinery has only a limited use in field planting. Most of the cost is for the hire of laborers. The work comes in the early spring or late fall, when other outdoor work is scarce. Every effort was made to afford a maximum of unemployment relief. Where possible, crews were rotated so as to provide some work for as many men as might be, and heads of families were given preference. Except for a few nursery laborers, the employment does not last more than a few weeks; but the available jobs were eagerly sought, and the efficiency of the laborers was above the average of previous years.

The areas planted and sown on national forests during the calendar year 1931 are shown, by States, in Table 9.

TABLE 9.—*Planting and sowing on national forests, by States, calendar year 1931*

State	Area planted	Area sown	Total	State	Area planted	Area sown	Total
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>		<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Michigan.....	12,781.00	-----	12,781.00	North Carolina....	50.40	-----	50.40
Idaho.....	2,414.00	-----	2,414.00	Florida.....	37.50	-----	37.50
Washington.....	1,949.00	-----	1,949.00	Utah.....	20.50	-----	20.50
Colorado.....	1,737.07	-----	1,737.07	Puerto Rico.....	19.90	3.50	23.40
Montana.....	1,642.30	-----	1,642.30	New Mexico.....	16.80	-----	16.80
Pennsylvania.....	1,625.10	-----	1,625.10	Tennessee.....	13.00	-----	13.00
Wisconsin.....	1,349.00	-----	1,349.00	Arkansas.....	8.70	-----	8.70
Nebraska.....	1,118.09	-----	1,118.09	New Hampshire.....	8.10	-----	8.10
West Virginia.....	952.80	-----	952.80	Arizona.....	5.00	-----	5.00
California.....	434.75	-----	434.75	Louisiana.....	3.00	-----	3.00
Wyoming.....	211.30	-----	211.30	Nevada.....	2.00	-----	2.00
Minnesota.....	153.00	-----	153.00				
Oregon.....	152.00	-----	152.00	Total.....	26,814.85	3.50	26,818.35
Virginia.....	110.54	-----	110.54				

RANGE

Except for a large part of Arizona and New Mexico and a small part of northwestern Wyoming, where moisture and forage conditions were better than normal, all the western range suffered in 1931 from severe drought. In Montana and northern Idaho it was the fourth consecutive dry year, the fifth in Washington and Oregon, the apparent climax of some 12 years in California and Nevada, and the worst for from 3 to 10 years in Utah and southern Idaho. In Colorado, most of Wyoming, northern New Mexico, and northern Arizona the drought was one of the severest ever recorded. South Dakota had severe grasshopper infestations as well as drought.

Although, as usual, the conditions were much worse outside than within the national forests, many of the forest ranges were put to the severest tests in their history. Areas entirely unutilized by domestic stock had the appearance of being overgrazed. There was little or no regrowth, and in places a shortage of forage developed. In South Dakota and the Northwest some sheepmen had to haul water for their flocks. To alleviate the shortage watering facilities were installed by the Forest Service and stockmen in considerable numbers.

In response to a recommendation of the directors of extension and Governor Dern, of Utah, a governors' conference met in Salt Lake City in July, 1931, to consider comprehensive measures of relief. This was attended by the Forester and other Forest Service officers. Following the conference instructions were issued to the regional foresters to extend grazing seasons and otherwise offer relief wherever it could be done without permanent injury to the forest ranges. In a few cases the ranges could not carry the stock the full season, and the grazing fees were correspondingly refunded.

Despite the bad season most of the livestock came off the ranges in fair to normal flesh. Early fall storms closed most of the ranges in November. Practically everywhere the late fall rains and winter snows were unusually heavy. While this greatly improved the outlook for 1932, it inflicted on livestock growers abnormal winter expenses and losses. The shortage of hay and winter pasture made necessary in many places heavy feeding of shipped-in concentrates. Large losses were sustained from snow. On the whole, the year was one of the severest ever known for the range-livestock industry of the West.

Declining markets aggravated the unfavorable conditions. Livestock values in the fall of 1931 were about 50 per cent under those of 1929 and from 30 to 35 per cent under those of 1930. Credits were restricted, securities crippled and many livestock loans placed in precarious condition. Operating expenses had to be curtailed to the absolute minimum, and this led to insistent demands for reductions in fees as a matter of emergency relief. After full consideration of the effect of the drought and the severe winter, announcement was made in February that the fees for 1932 would be reduced by 50 per cent and that their payment would be deferred to December 1, 1932. In harmony with the policy which has been consistently maintained by the Department

of Agriculture, this action was not taken in view of the general economic situation, but was in recognition of severe natural conditions. The grazing fees are fixed on the basis of a reasonable and fair rate over a period of years, irrespective of fluctuations in market and other economic conditions from year to year. It is believed to be a thoroughly sound premise that in consideration of the value of the feed and the security of use given permittees it is to the benefit of all to maintain a reasonable fee on a fairly permanent and stable basis. This was the object sought when the present fee schedule was fixed in 1927, and continuation of the same schedule for the next term-permit period, beginning in 1935, is contemplated.

Table 10 shows the grazing use made of the national forests in the calendar year 1931.

TABLE 10.—*Grazing permits issued and numbers of stock allowed under pay permit on the national forests, by States, calendar year 1931*

State	Cattle, horses, and swine				Sheep and goats		
	Permits issued	Stock grazed			Permits issued	Stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Alabama.....	1	15					
Arizona.....	957	185,536	1,465	204	117	390,033	3,345
Arkansas.....	76	1,378	11		1		10
California.....	1,840	142,032	4,380	125	333	397,837	1,327
Colorado.....	2,868	280,446	2,777		898	1,036,853	33
Florida.....	22	2,223			2	899	
Idaho.....	2,553	113,856	6,199		989	1,324,718	
Montana.....	1,888	126,200	6,223		470	613,291	87
Nebraska.....	30	11,192	442				
Nevada.....	369	50,305	2,117		163	335,238	
New Hampshire.....	19	190	4				
New Mexico.....	1,966	86,197	2,651	102	270	217,044	9,592
North Carolina.....	71	330	1		3	38	
Oklahoma.....	46	2,397					
Oregon.....	1,066	81,170	2,009		490	655,014	50
Pennsylvania.....	2	57					
South Dakota.....	588	28,416	986		56	34,193	
Tennessee.....	38	312			3	105	
Utah.....	3,722	168,249	3,678		2,016	774,720	201
Virginia.....	101	1,035	10		19	558	
Washington.....	417	12,334	409		151	150,494	
West Virginia.....	32	420	15		33	731	
Wyoming.....	716	104,083	3,958		305	661,817	
Total, 1931.....	19,388	1,338,373	37,335	431	6,319	6,593,583	14,645
Total, 1930.....	19,969	1,315,882	41,961	540	6,484	6,700,846	13,496

The numbers of stock shown for 1930 are not the same as were reported a year ago. Last year the form of the statistical records was changed to show the number of stock allowed to graze instead of the number actually grazed. This has disrupted the continuity of the statistics. In 1931, 17,865 more cattle and horses than in 1930 were allowed to graze on the forests under the pay permits issued, but 106,114 fewer sheep and goats. Thus the general tendency of previous recent years to change from cattle to sheep was reversed. The actual use during 1931 was the equivalent of 17,000 cow months more than in 1930.

In reports previous to 1930 the tables showing the numbers of stock grazed did not take into account duplication where stock grazed on two forests for different parts of the same season. This duplication has been eliminated in the showing for 1931. In that year interforest grazing by 7,787 cattle, 328 horses, and 108,348 sheep was allowed.

In 1931 about 3 per cent fewer owners received grazing privileges than in 1930; but the average number of cattle and horses per permittee was 71, as against 68 in 1930, and of sheep and goats 1,046, as against 1,036.

Livestock owners residing adjacent to the forests are allowed to graze free of charge up to 10 head of stock used for domestic purposes. In the calendar

year 1931 the exempt stock on the forests comprised 24,528 cattle, 42,456 horses, 4,555 swine, 4,661 sheep, and 742 goats.

RANGE IMPROVEMENTS

In the construction of range improvements special attention was given to the relief of local unemployment. The expenditures in the calendar year 1931 from Federal funds and cooperative contributions exceeded those of 1930 by \$117,452. The construction included 1,044 miles of fence, at a cost of \$251,920; 22 corrals, which cost \$2,691; 236 miles of driveway, for \$5,969; 15 stock bridges, for \$8,212; and 842 water developments at a cost of \$95,577; a total of \$364,369. In addition some special game-control fences were constructed on the Wichita National Forest and Game Preserve in Oklahoma, at a cost of \$58,141. In this section the effects of the 1930 drought were particularly severe, and the local employment afforded the heads of many needy rural families helped substantially to relieve an urgent situation.

STABILITY OF RANGE USE

Market conditions constitute a large factor in livestock turnover and seriously affect credit and the ability of the stockman to work out his problems. Stability of operation on the national forests has been strengthened, however, by the recognition and protection of preferences and by term or 10-year permits. This has led to more personal interest on the part of permittees in their range allotments and to better range management. On many forests or parts of forests where the distribution of privileges could not be extended without unduly curtailing, and indeed penalizing, present users, ranges have been closed to the beginner demand. As this has become locally known, formal new applications have been greatly lessened, but the demand would always be far beyond the capacity of the ranges if they were open to all comers.

Coincident with the protection of preferences there has also been a liberal policy of nonuse, enabling the permittee in times of distress to protect his base of operation pending the readjustment of his affairs. These concessions are for from one to three years, their length depending upon general conditions and the individual case, but they are rarely for more than two years. In 1931 nonuse was granted for 81,976 cattle and 241,000 sheep; this was for 7,321 fewer cattle and for 1,196 more sheep than in 1930. The strong trend from cattle to sheep which obtained for several years was effectively stopped by the depression in the sheep industry and some tendency back to cattle raising set in on the ranches in mountain communities.

Unfavorable conditions in the livestock industry, whether due to economic or to natural causes, emphasize the contrast between regulated and unregulated range and the resulting benefits to users of the former. Never before has the need for some form of administration of the public domain been so clearly demonstrated as during the past two years. At a time when a large surplus of cheap native forage was most needed, the winter, spring, and fall ranges on the public domain were bare of the nutritious grasses and brush which they once so abundantly produced. The inevitable result has been heavy losses and increased costs for supplemental feed. Such conditions, however, are forcing public attention to the fact that the public domain is an important part of the agricultural plant of the Nation. Its wise and conservative use is an essential element in better watershed protection, the prevention of erosion and of silt deposit in reservoirs, canals, and ditches, and the preservation of the forage crop. Its relation to the national forests is becoming more clearly visualized and the imperative need of administration recognized. It is gratifying, therefore, to record the advance made during the past year in study of the problem and the proposal of legislation which, if enacted into law, will accomplish the purposes that have been so urgently advocated by the Forest Service for the past 27 years.

RECREATION AND GAME

During the year recreational use of the national forests took on an increased economic significance. To many regions it attracted sources of income without which much financial hardship would have been felt. To many unemployed

persons it afforded not only enjoyment and health but also opportunity to live inexpensively amidst pleasant surroundings. Many parties occupied national-forest lands for extended periods. As in earlier years, the campers came from practically all the States and Territories. An exact census of visitors is impracticable, but estimates made as in previous years, with every effort to avoid duplications, indicated that during the calendar year 1931 visitors to the national forests numbered 32,108,043, an increase of about 480,400. They included 493,235 special-use permittees and guests, 1,618,510 hotel and resort guests, 2,193,843 campers, 3,765,027 picnickers, and 24,037,428 transient motorists. While the majority of the latter merely passed through the national forests, a substantial part of the motor travel is specifically to enjoy the scenic attractions of the forests and is as definite a use of them as camping or picnicking.

This heavy and increasing use continually emphasizes the need for better and more extensive improvement of the national-forest public camp grounds. While 1,800 camp grounds now are at least partly equipped with sanitary facilities, few are adequately equipped, and some heavily used areas have no facilities whatever. The resulting hazards to public health and property should be eliminated as fast as possible. The total cost of improving the 1,800 camp grounds to December 31, 1931, was \$422,655, of which \$54,866 was contributed by public and private cooperators, in money, services, materials, or supplies.

The annual report for 1930 mentioned the alarm felt by some stockmen about the increases in big-game animals on certain forests. Under the announced policy of according all interests consideration under a balanced program, the so-called conflicting interests are gradually coming together and working out problems and programs as need for this arises. All big-game animals, deer and elk especially, are increasing. The estimates for 1931 show nearly 1,200,000, all told. The increase of almost 9 per cent over the 1930 estimates is attributable almost wholly to deer and elk.

Including their young, some 14,000,000 domestic animals are accommodated on about 82,761,612 acres of grazing lands in the western national forests. On an additional nearly 50,000,000 acres of mountain country large amounts of forage are produced, but are not used by domestic stock. This is available to wild life for food and cover, mostly during summer periods. Game also occupies large areas in common with domestic stock. It is mostly on these areas that problems of correlation arise, on which cooperation of the different interests is especially solicited and encouraged. Preliminary game-management plans in anticipation of possible problems are being developed for important elk and deer herds, in an effort to forestall a repetition of the situation which arose on the Kaibab Forest. Such plans have been worked up for some 30 important elk herds of the West, with a view to cooperation in their application. It is important that the wild-life resource be controlled and its use harmonized with that of other resources through plans of management consistent with and based on a proper sense of proportion.

The larger game problems are encountered, however, not so much on the national-forest summer ranges as on the winter ranges outside the forests, which are under no form of control. The winter ranges are becoming more and more the limiting factor with respect to the numbers of game that can be accommodated in a given region. In many localities summer range is available much beyond the needs of the present game population. If some provision of regulation for the public domain is made, it will go a long way toward solving the growing winter range problems for game in the western national-forest regions.

The national forests harbor also large numbers of game birds and fur bearers. For some years there was an unfortunate decline in the numbers of grouse, apparently due to disease, but this seems to have been arrested, and the 1931 reports show a gratifying improvement. Fur bearers, in round numbers, aggregate nearly 900,000 animals of different kinds, the principal of which is beaver. Important opportunities are developing to treat fur bearers as a resource, on a fur-farming basis. On a number of national forests forest officers cooperate with the State authorities in passing upon applications for trapping permits, in laying out trapping districts, and in controlling the numbers taken, in a way designed to foster this important resource.

TABLE 11.—*Number of big-game animals on national forests, by States, estimated as of December 31, 1931*

State	Antelope	Bear		Deer	Elk	Moose	Mountain goats	Mountain sheep
		Black or brown	Grizzly					
Alabama.....				600				
Alaska.....		5,750	1 3,000	75,600	26	500	11,000	1,500
Arizona.....	5,445	660	3	90,400	5,150			280
Arkansas.....		4		1,820				
California.....	1,605	8,482		284,360	129			405
Colorado.....	112	2,678	17	41,160	12,215			3,511
Florida.....		185		2,475				
Idaho.....	2,500	5,063	61	66,405	9,230	427	2,779	1,619
Michigan.....		135		5,195		4		
Minnesota.....		1,600		8,650	14	2,830		
Montana.....	863	5,722	465	52,130	15,255	1,617	4,103	1,869
Nebraska.....				95				
Nevada.....	195	2		9,095	1			145
New Hampshire.....		880		3,945		10		
New Mexico.....	1,110	990	11	86,800	760			100
North Carolina.....		256		5,775	25			
Oklahoma.....		4		400	375			
Oregon.....	425	6,457	2	97,955	10,160			61
Pennsylvania.....		300		5,000	5			2
South Dakota.....				4,150	255			
Tennessee.....		25		440				
Utah.....		496	1	65,315	2,725			179
Virginia.....		520		150	75			
Washington.....		8,470	11	36,170	9,430	3	4,380	6
West Virginia.....		300		100				
Wyoming.....	470	1,563	176	18,845	31,075	2,444		2,878
Wisconsin.....		54		6,300				
Total.....	12,725	50,596	3,747	969,330	96,905	7,835	22,262	12,555

¹ Includes Alaska brown bear.

WATER POWER

On June 30, 1932, 222 water-power permits issued by the Department of Agriculture prior to the Federal water power act were in force. They comprised 106 permits or easements for water-power projects, with an average low-flow output estimated at 535,814 horsepower, and 116 permits or easements for transmission lines only, with a total length of 998.36 miles within the forest boundaries. The permits for 53 of the power projects, with an estimated output of 510,024 horsepower, and for 95 of the transmission-line cases, with a length of 844.28 miles within the forest boundaries, require the payment of an annual rental. The estimated average output of the power projects covered by free permits was 25,790 horsepower. The free permits for transmission lines cover a length of 154.08 miles within the forests.

The Forest Service continued to assist the Federal Power Commission through doing certain investigational, reporting, and supervisory work. It also helped in the valuation and accounting work in a few cases. At the end of the year the Forest Service, at the request of the commission, was supervising the operations of 354 permittees or licensees under the Federal water power act. During the year the commission requested 34 investigations and reports in cases of application for permit or license. A total of 42 such reports were made. The Forest Service also made five appraisals or valuations. Out of a total of 42 applications for permits or licenses received by the commission during the year, 29, or 69 per cent, involved the use of national-forest land.

The general economic conditions materially decreased the number of new enterprises seeking to develop water-power resources within the national forests, and this has lessened somewhat the time required for making investigations and reports on new applications; but the time required for supervision was increased somewhat, because more cases were under permit or license. During the year much consideration was given to the proper method of handling cases where the land involved has value for more than one use. The problem is a difficult one, and the number of cases of conflict is increasing. Right now the cases of desired roads crossing land of water-power value are the most numerous and are giving the most difficulty. There are, however, many cases of conflict of water power with other uses of water and with the use of land for railroads, recreation, and other purposes.

For many years a great need has existed for more accurate and complete information on the water-power resources of the national forests—their amount

and location, the economic feasibility of their development, and the value of the land for water power as against other purposes. Much scattered information is already available through work that has been done by the States, the United States Geological Survey, the Forest Service, and other agencies. The Forest Service has elaborated a plan for collecting all the available data, expressing them in a standardized manner, and gradually supplementing them, through its own efforts and with such other assistance as can be secured. Gradually the data will be secured, but with the present limited personnel and funds progress will be very slow. An active beginning of the task has not yet been possible. When the planned work is completed, it will decidedly facilitate administration of the national forests, especially in matters relating to permitted land use. There will be far greater assurance that land is utilized for its highest value, that the highest use is not denied because the land has been wrongly classified, that provision for use for two purposes will be made when adjustments of conflicts can be worked out, and that developments will not be made or utilization permitted for purposes other than power where the power value is predominant and coordinated use is impracticable.

ROADS AND TRAILS

Table 12 shows the present status of the transportation system planned for the national forests. This system includes (1) forest highways, of primary importance to States, counties, and local communities; (2) forest-development roads, of primary value for protection, administration, development, and utilization of the forests; and (3) trails, of primary value for protection. Table 13 shows the mileage constructed and maintained and the expenditures made from all Federal and cooperative funds, to the close of the fiscal year 1932; and Tables 14, 15, and 16 show the apportionments of the various forest-road appropriations among the States and Territories and the status of these appropriations at the end of the year.

TABLE 12.—*Classification of mileage in forest road and trail system and expenditures required to complete the system to a satisfactory standard*

Class	Total	Satisfactory standard	Unsatisfactory standard	Non-existing	Expenditures required to complete
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Dollars</i>
Forest highways.....	16,534	6,259	9,053	1,222	\$175,626,400
Forest-development roads.....	68,222	26,374	16,871	24,977	58,639,600
Total roads.....	84,756	32,633	25,924	26,199	234,266,000
Trails.....	165,058	120,602	11,566	32,890	5,189,000
Total.....					239,455,000

TABLE 13.—*Construction, improvement, and maintenance of roads and trails from forest-road appropriations and other Federal and cooperative funds, by States, June 30, 1932*

State	Fiscal year 1932				Total to June 30, 1932		Expenditures to June 30, 1932		
	Constructed		Maintained		Constructed		Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails	Roads	Trails			
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>			
Ala.....	5.6		182.8		67.3		\$165,765.12	\$25,278.16	\$191,043.28
Alaska.....	9.9	77.9	218.4	417.0	247.0	517.6	6,190,830.03	377,747.35	6,568,577.38
Ariz.....	163.2	59.6	798.5	976.0	1,970.2	1,736.6	1,695,858.33	1,695,858.33	8,865,353.86
Ark.....	79.5		526.7	571.4	641.8	571.4	1,658,020.49	48,370.89	1,706,391.38
Calif.....	930.4	242.8	11,381.1	18,993.6	4,569.5	11,398.6	19,443,991.71	5,756,678.10	25,200,669.81
Colo.....	94.4	346.9	881.6	11,484.1	1,575.3	5,414.2	8,634,331.74	988,575.83	9,622,907.57
Ida.....	33.7		667.9		537.9		556,683.72	138,661.18	695,344.90
Ia.....	10.1		219.8	329.4	122.4	329.4	630,345.41	80,327.17	710,672.58
Idaho.....	319.5	2,241.8	3,246.1	21,167.1	2,682.8	20,550.1	18,379,741.87	1,873,051.36	20,252,793.23
Ill.....							434.13		434.13
Kans.....					3.4		2,111.51		2,111.51
Ky.....							808.72		808.72
La.....	42.3		95.5		135.0		24,805.57		24,805.57
Me.....	1.0	1.0	7.4	68.0	7.4	68.0	56,987.78		56,987.78
Md.....							70.05		70.05
Mich.....	210.2		537.4		470.7		250,141.30	33,303.49	283,444.79
Minn.....	54.4	48.9	270.5	403.3	444.7	585.6	1,013,767.47	268,277.07	1,282,044.54

TABLE 13.—*Construction, improvement, and maintenance of roads and trails from forest-road appropriations and other Federal and cooperative funds, by States, June 30, 1932—Continued*

State	Fiscal year 1932				Total to June 30, 1932		Expenditures to June 30, 1932		
	Constructed		Maintained		Constructed		Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails	Roads	Trails			
	Miles	Miles	Miles	Miles	Miles	Miles			
Mont.....	87.2	1,794.6	2,491.3	18,195.0	1,226.4	18,194.9	\$11,246,125.43	\$650,423.24	\$11,896,548.67
Nebr.....	3.2		48.8		51.5		113,650.20	990.80	114,641.00
Nev.....	44.5	19.0	407.0	1,669.5	528.4	915.1	1,875,182.36	168,005.90	2,043,188.26
N. H.....	3.2	1.5	54.2	552.5	63.1	552.5	479,946.24	64,094.55	544,040.79
N. J.....							217.71		217.71
N. Mex.....	99.3	40.5	976.2	1,357.0	1,184.8	1,598.5	5,450,093.84	330,316.13	5,780,409.97
N. Y.....							81.32		81.32
N. C.....	8.6		213.2	625.0	209.3	635.0	952,165.96	449,402.16	1,401,568.12
N. Dak.....					1.0		57.75		57.75
Okla.....	7.0		32.0	1.5	34.7	16.5	100,827.90	14,192.14	115,020.04
Oreg.....	519.4	643.9	7,499.2	15,103.0	4,196.1	8,031.9	17,073,508.63	7,612,243.71	24,685,752.34
Pa.....	18.0		249.0	23.0	67.1	23.0	238,821.17	42,142.06	280,963.23
P. R.....				36.3	6.6	36.3	28,512.06	550.00	29,062.06
S. C.....			12.0	18.2	6.3	18.2	113,544.62	15,659.81	129,204.43
S. Dak.....	29.9	7.5	173.7	40.5	340.7	85.1	1,065,596.78	244,046.11	1,309,642.89
Tenn.....	7.5	21.0	140.2	800.3	98.9	809.3	569,155.31	189,884.30	759,039.61
Utah.....	53.5	184.6	926.1	3,693.4	1,211.2	3,693.4	4,437,230.27	957,632.99	5,394,863.26
Va.....	2.0		217.8	865.2	136.5	917.3	773,588.24	51,691.53	825,279.77
Wash.....	225.7	918.8	2,243.4	13,333.4	1,526.3	7,735.5	11,036,847.65	1,700,981.78	12,737,829.43
W. Va.....	3.6		140.8	476.4	120.6	480.2	406,753.34	38,159.30	444,912.64
Wis.....	49.8		68.2		118.7		95,677.38	1,820.00	97,497.38
Wyo.....	57.7	244.3	817.5	6,017.8	1,073.6	2,488.3	5,679,399.01	390,197.32	6,069,596.33
Total.....	3,174.3	6,894.6	35,744.3	117,217.9	25,677.2	87,402.3	125,915,315.12	24,208,562.96	150,123,878.08

TABLE 14.—*Distribution among the States for the apportionments for the fiscal year 1933*

State	10 per cent fund	Forest highways	Forest road development	Total
Alabama.....	\$30.19	\$13,615.00	\$5,587.00	\$19,232.19
Alaska.....	4,202.12	350,000.00	12,480.00	366,682.12
Arizona.....	19,066.31	984,268.00	120,557.00	1,123,891.31
Arkansas.....	173.49	153,712.00	60,924.00	214,809.49
California.....	59,761.58	2,347,672.00	500,041.00	2,907,474.58
Colorado.....	23,192.75	1,125,042.00	133,739.00	1,281,973.75
Florida.....	2,064.62	57,740.00	18,100.00	77,904.62
Georgia.....	559.36	33,222.00	14,373.00	48,154.36
Idaho.....	23,395.31	1,738,572.00	703,698.00	2,465,665.31
Illinois.....		1,352.00		1,352.00
Louisiana.....	44.59	6,764.00	5,318.00	12,126.59
Maine.....	123.50	4,731.00	2,509.00	7,363.50
Michigan.....	254.50	36,344.00	27,351.00	63,949.50
Minnesota.....	1,193.47	107,347.00	11,930.00	120,470.47
Mississippi.....		5,567.00	5,487.00	11,054.00
Montana.....	11,897.20	1,359,477.00	255,905.00	1,627,279.20
Nebraska.....	452.78	16,331.00	1,764.00	18,547.78
Nevada.....	4,759.15	314,610.00	12,155.00	331,524.15
New Hampshire.....	1,824.50	75,196.00	20,349.00	97,369.50
New Mexico.....	8,309.09	691,794.00	81,529.00	781,632.09
North Carolina.....	1,240.76	49,340.00	21,306.00	71,886.76
Oklahoma.....	277.37	10,879.00	9,117.00	20,273.37
Oregon.....	14,619.03	2,187,932.00	357,435.00	2,559,986.03
Pennsylvania.....	709.80	32,045.00	31,931.00	64,685.80
Puerto Rico.....	14.52	1,837.00	1,806.00	3,657.52
South Carolina.....	107.49	5,583.00	1,975.00	7,675.49
South Dakota.....	3,309.10	131,223.00	13,355.00	147,887.10
Tennessee.....	853.76	42,530.00	16,471.00	59,854.76
Utah.....	9,932.20	561,990.00	42,875.00	614,797.20
Vermont.....	.60	5,406.00	829.00	6,235.60
Virginia.....	1,232.39	53,925.00	27,741.00	82,898.39
Washington.....	19,384.95	1,206,941.00	395,844.00	1,622,169.95
West Virginia.....	158.56	26,488.00	15,692.00	42,338.56
Wisconsin.....	36.39	14,521.00	14,208.00	28,765.39
Wyoming.....	14,121.17	745,994.00	55,619.00	815,734.17
Undistributed.....			¹ 5,000,000.00	5,000,000.00
Total.....	227,302.60	² 14,500,000.00	8,000,000.00	22,727,302.60

¹ Emergency improvement appropriation.² Includes \$5,000,000 emergency forest highways, fiscal year 1933.

TABLE 15.—*Distribution among States of the total apportionments, including the fiscal year 1933*

State	10 per cent fund	Section 8	Federal forest-road construction	Forest highways	Forest-road development	Improvement	Grand total
Ala.	\$968.96	\$15,456.04	\$1,922.31	\$59,774.00	\$87,184.00	\$16,800.00	\$182,105.31
Alaska	170,809.45	471,395.52	193,549.95	6,295,184.00	249,114.00		7,380,052.92
Ariz.	652,823.57	681,138.25	501,984.55	4,823,576.00	1,625,371.00	309,613.93	8,594,501.30
Ark.	130,493.23	175,055.50	128,773.38	670,791.00	625,045.00	215,639.38	1,945,797.49
Calif.	1,688,923.03	1,469,017.69	1,206,815.23	11,629,532.00	5,059,565.00	863,185.43	21,917,038.38
Colo.	776,597.58	760,830.87	777,307.26	5,645,592.00	1,892,233.00	46,932.52	9,899,493.23
Fla.	44,574.34	119,528.14	21,534.94	229,859.00	171,835.00	92,218.38	679,549.80
Ga.	12,776.97	52,393.57	134,887.16	147,711.00	213,509.00	110,753.71	671,103.24
Idaho	988,057.69	1,199,487.36	1,367,402.82	8,607,763.00	7,275,982.00	1,283,501.39	20,722,194.26
Ill.				4,845.00	396.00		5,241.00
Kans.	1,867.27						1,867.27
Ky.	722.72				86.00		808.72
La.	45.24			7,793.00	10,586.00	19,500.00	37,924.24
Me.	3,943.63	32.41	3,738.77	22,735.00	28,866.00	1,788.46	61,104.27
Md.	70.05						70.05
Mich.	4,076.33	115.63	3,000.00	96,625.00	122,644.00	100,493.78	326,954.74
Minn.	44,045.59	8,316.42	108,352.03	512,221.00	374,148.00	90,099.07	1,137,182.11
Miss.				5,567.00	5,487.00		11,054.00
Mont.	610,233.61	756,984.58	731,497.39	6,824,637.00	3,588,808.00	450,072.13	12,962,232.71
Nebr.	19,859.17	18.98		82,249.00	32,135.00	578.27	134,840.42
Nev.	183,011.69	195,305.50	82,265.33	1,606,455.00	162,343.00	19,002.61	2,248,383.13
N. H.	52,676.49	365.35	10,941.30	329,835.00	176,371.00	20,611.54	590,800.68
N. J.	118.99				83.00		201.99
N. Mex.	360,453.72	430,944.25	509,215.36	3,513,263.00	1,244,449.00	233,686.07	6,292,011.40
N. Y.	4.00				20.00		24.00
N. C.	38,956.10	84,733.83	176,890.28	229,779.00	342,843.00	123,322.28	996,524.49
N. Dak.	45.75	7.00					52.75
Okl.	10,699.75	65.49	2,775.17	40,307.00	42,705.00	22,257.56	118,809.97
Oreg.	1,049,646.98	1,433,786.19	1,077,552.29	10,393,589.00	5,118,492.00	557,938.01	19,631,004.47
Pa.	5,437.30	24.04	21.42	104,063.00	153,145.00	38,000.00	300,690.76
P. R.	134.62	7.00	3,343.09	9,888.00	17,005.00	1,904.35	32,282.06
S. C.	3,188.43	402.10	48,028.61	25,560.00	49,408.00		126,587.14
S. Dak.	187,518.71	83,868.26	79,341.53	639,928.00	228,313.00	24,548.87	1,243,518.37
Tenn.	20,624.01	103,480.74	28,092.79	192,579.00	237,917.00	35,421.69	618,115.23
Utah	417,326.54	446,385.03	464,562.35	2,865,534.00	734,388.00	88,523.42	5,016,719.34
Vt.	.60			5,406.00	829.00		6,235.60
Va.	47,313.79	58,390.16	71,902.26	256,520.00	340,797.00	93,508.90	868,432.11
Wash.	679,891.45	940,440.30	712,201.40	5,775,566.00	3,847,220.00	650,974.74	12,606,293.89
W. Va.	6,144.88	12,830.41	5,049.24	103,423.00	193,779.00	123,931.31	445,157.84
Wis.	37.02			23,051.00	29,754.00	73,380.61	126,222.63
Wyo.	463,461.75	472,621.77	547,551.79	3,718,800.00	1,217,145.00	46,842.71	6,466,423.02
Undistributed		26,571.62				1 5,000,000.00	5,026,571.62
Total	8,677,581.00	10,000,000.00	9,000,000.00	275,500,000.00	35,500,000.00	310,755,031.12	149,432,612.12

1 Emergency improvement, fiscal year 1933.

2 Includes \$3,000,000 appropriated for emergency highways within national forests, fiscal year 1931, and \$5,000,000 for emergency forest highways, fiscal year 1933.

3 Does not include \$27,168.88 unexpended balance in annual funds.

TABLE 16.—*Condition of forest-road funds on June 30, 1932*

Fund	Appropriations	Expenditures	Balance
10 per cent	\$8,450,278.40	\$8,059,532.36	\$390,746.04
Section 8	10,000,000.00	9,973,428.38	26,571.62
Federal forest-road construction	9,000,000.00	9,000,000.00	
Forest highways ¹	58,055,000.00	57,428,647.56	626,352.44
Forest-road development	32,500,000.00	32,014,095.53	485,904.47
Improvement ²	5,782,200.00	5,755,031.12	
Total	123,787,478.40	122,230,734.95	1,529,574.57

1 Includes emergency funds.

2 Annual funds, \$27,168.88, not expended.

The act of June 24, 1930, set up appropriation authorizations for the fiscal years 1931, 1932, and 1933. These provided for each fiscal year \$9,500,000 for forest highways and \$3,000,000 for forest-development roads and trails. Of the authorization for forest highways for the fiscal year 1933 there will be an unappropriated balance of \$6,540,000. An authorization for the fiscal years

1934 and 1935, similar to those made in the past, was passed in the House but not in the Senate. There will therefore be no forest-road-development funds and only \$6,540,000 forest-highway funds available for expenditure in the fiscal year 1934 unless Congress takes further action at its next session.

The emergency relief act, which became a law on July 21, 1932, provided an additional \$5,000,000 for forest highways and \$5,000,000 for improvements upon the national forests. The former was apportioned in the same manner as the regular forest-highway fund, except that Alaska did not share in the appropriation. The emergency improvement fund was so apportioned to the national-forest States that the total available to each forest region for road and trail work approximated the amount allotted for the fiscal year 1931. The purpose of the act was to assist in the unemployment situation, and a number of stipulations were included which required special regulations to assure carrying out the wishes of Congress and assure that a maximum proportion of the appropriations will be expended for labor. The entire \$10,000,000 must either be expended or obligated through contracts during the present fiscal year.

MAPS AND SURVEYS

During the year the Forest Service published for administrative use 18 quarter-inch scale maps, 25 half-inch scale maps, and six 1-inch scale maps of individual national forests. There were also published in cooperation with the State Department 11 maps to accompany proclamations and Executive orders. Small editions of 72 miscellaneous maps, charts, tables, graphs, and illustrations were issued.

Surveys were completed by Forest Service personnel on mapping projects covering 2,470 square miles. This mapping was done on widely scattered areas, to the accuracy and scale required to meet special requirements of forest administration.

RESEARCH

Substantial advance was made in the whole research program. Particularly vigorous effort was directed toward finding out what to do with the extensive and rapidly accumulating areas of abandoned cut-over forest lands, and what methods of cutting and management will give the best results on privately owned forest land. In the latter group of studies special emphasis was placed on investigations relating to selective cutting and sustained-yield operation.

Previous reports have pointed out that research in forest and range management, forest economics, and erosion is largely concentrated at 11 forest and range experiment stations, so distributed as to cover all of the important forest regions of the continental United States. In connection with them a series of experimental forests is being created to serve as field laboratories, where intensive investigations in silviculture, range management, and related phases of forest research can be carried on undisturbed and under controlled conditions over as long periods as may be necessary.

Toward the end of the year the headquarters of the northeastern station were moved from Amherst, Mass., to New Haven, Conn. The station will work in close cooperation with Yale University, which has provided the necessary office and laboratory space.

The funds made available for research activities under various appropriation items for the fiscal year 1932 are compared with the amounts for 1931 and 1933 in Table 17.

TABLE 17.—*Appropriations for research for 1932 as compared with those for 1931 and 1933*

Class of research	1931	1932	1933
Forest-management investigations.....	\$488, 500	\$562, 000	\$534, 280
Forest-products investigations.....	635, 000	641, 300	613, 640
Range investigations.....	85, 000	130, 000	123, 030
Forest-economics studies.....	50, 000	75, 000	70, 240
Forest survey.....	125, 000	200, 000	170, 280
Forest-taxation study.....	70, 000	70, 200	51, 120
Forest-insurance study.....	10, 000	10, 000	15, 000
Erosion-stream-flow studies.....	30, 000	100, 000	89, 160

FOREST-ECONOMICS INVESTIGATIONS

Time and cost studies of logging operations in the Douglas-fir region of Washington and Oregon were completed. While the cost of logging varies markedly both with the size of timber and to a less extent with the distance of haul, a wide variation is also shown with various types of equipment. In many instances large savings could be made by the adoption of different methods or equipment from those now in use, as well as by more careful selection of the timber to be logged.

The investigation of the problem of forest insurance in the Douglas-fir region was continued, including studies of the relationship between seasonal climatic factors and fire hazard. The prices of stumpage and logs in 1930, based on a large number of transactions in all forest regions of the United States, were compiled and published as a statistical bulletin. Records of the prices for the years 1923-1927 were made available in a multigraphed report. Estimates of the forest resources and requirements of the United States were revised. A special compilation embodying the main results of this study was made for the use of the President's Timber Conservation Board. More detailed reference to the general findings will be found elsewhere in this report.

A continuing investigation of the financial aspects of forestry in the southern pine region covered typical pine counties in Arkansas, Louisiana, and Texas. Results of the work under this project in Washington County, Fla., were published in a bulletin of the Florida Forest Service. The studies so far made indicate that a large part of the southern pine area will yield fair returns from forest growing if the ground is kept reasonably well stocked with trees, but that the present stocking over much of the region is exceedingly inadequate.

An investigation of the reversion of land to public ownership, with special reference to land that is now in forest or is suitable for forestry purposes, was begun in the Lake States, the Southern States, and the Pacific Northwest. A preliminary reconnaissance of the situation was made in eight Southern States and in the forest counties of northern Minnesota and a more intensive study was undertaken in Arkansas in cooperation with the State college of agriculture. In several States much forest land has ceased to pay taxes, and large increases in the amount of such land are in prospect. Its ownership status is generally very uncertain. Few States have any definite policy for dealing with it. The problem of ownership and utilization of this reverted land has a very direct bearing upon policies for both public and private forestry.

THE FOREST SURVEY

Progress on the nation-wide forest survey was accelerated, both in the inventory of the extent and quality of the remaining timber supplies and the condition of cut-over and burned forest land and in the study of the factors influencing the trends in the consumption of forest products. In the Douglas-fir region of the Pacific Northwest completion of the inventory is expected during the fiscal year 1933. Studies of the growth and yield in the region and of the rate of forest depletion were inaugurated and should now keep pace with the inventory, as should also the regional study of requirements for forest products. In the South the inventory in the Mississippi Basin hardwood region was begun in full force, starting in Mississippi. The field work for the hardwood inventory in that State will be completed early in the fiscal year 1933. Inventory procedure has been tested in the pine region, and the field force will be transferred to it, in Mississippi, on completion of their work on the hardwood area.

Cooperative work with the State land economic surveys in the Lake States resulted in substantial progress there. In some counties the work is bringing about land-use planning by the county authorities. In California, through cooperation with the State, the forest cover type map project made excellent progress. Arrangements were started to publish four of the maps, in response to insistent local demand for them with a view to their use in many different ways. The inventory was begun in the "Inland Empire" region (northern Idaho, western Montana, and eastern Washington) and substantial progress was made in central Idaho. A working plan for the wood requirements part of the survey was completed and sent to a number of interested agencies for review, and a substantial start was made in accumulating data bearing on the factors which have been influencing the decrease in the use of lumber, particu-

larly for construction. The plan provides for covering the whole field of forest products, including pulp and paper and naval stores.

Progress on the survey during the fiscal year 1933 will be slower, as the appropriation has been cut down substantially.

FOREST TAXATION

The principal activity of the forest-taxation inquiry has been the preparation of the textual part of the comprehensive report and the application of various proposed tax plans to field data, as a test of their feasibility in practice. Except for a few minor portions the entire report is expected to be in final draft before the close of the current calendar year. During the study a series of progress reports has made factual material available to the public as nearly currently as possible. Four were issued last year. They were: Taxation of Timber Properties in Oregon and Washington; Some Aspects of the Forest Tax Problem in Selected Towns of Wisconsin; Digest of Forest Tax Laws in the United States in Effect January 1, 1932; and Taxation of Forest Property in North Carolina. A preliminary edition of the forest tax law digest was prepared for the Federal Timber Conservation Board.

FOREST MANAGEMENT AND PROTECTION INVESTIGATIONS

Forest management and protection investigations seek better knowledge of the many forces which together determine forest productivity. In the virgin forest these forces are in a certain balance. As soon as this balance of nature is disturbed corresponding changes begin to show themselves in the character of the forest growth. They may be relatively temporary, or far-reaching. Their character and extent depend not only on the kind and amount of disturbance but also on the natural conditions. To apply forestry it is necessary to know how to control and direct the life of the forest.

Forest exploitation without regard to the consequences ordinarily produces forest degeneracy, which if continued, and especially if accompanied by fire, is certain to be progressive. In part, the forest management and protection investigations concern the methods by which virgin forests can be used and at the same time maintained in a high state of productivity; but in much larger part they must be directed at the methods of restoring to reasonable productivity the more or less degenerate, depleted, and sometimes all but worthless forests which severe or long-continued exploitation and the ravages of uncontrolled fires have put in place of the primeval stand. Land wholly denuded of valuable forest growth presents the problem of restoration in its most extreme form.

To obtain the knowledge indispensable in working out sound practices of forestry for all parts of the country, the Forest Service maintains its series of regional forest experiment stations. At these stations the problems presented by the enormous area of nonrestocking or poorly restocking lands in every part of the country, but chiefly in the eastern forest regions, have received special attention. In the Lake States, where abandonment of poor farm land and of denuded cut-over lands is increasing, much effort was devoted last year to ascertaining what to plant and how best to plant it. The successful reclamation of lands covered with brush and unmerchantable trees calls for discovering and using the species which will survive under the special light and soil conditions presented. On open lands, frequently the critical factors are infertile soils and lack of moisture, the latter particularly in times of drought. The investigations under way in the Lake States last year gave increased knowledge of the soil, light, and moisture conditions on which depend success in planting Norway pine and other native species.

In the South, slash pine (probably the fastest growing pine in North America) was studied to learn within what limits it can be planted successfully outside of its natural range, and outside of the wet flatlands where it is naturally found. Over how extensive an area it can be profitably grown is still an open question. More widespread planting of longleaf pine, another southern pine which furnishes both high-quality wood and abundant resin, has been facilitated by the outcome of tests establishing that longleaf seed may be held for several years without deterioration by cold-storage treatments. This makes it now possible to collect enough seed in good years to meet the needs until the next seed crop develops. Longleaf produces seed in abundance only at intervals of

everal years, and under ordinary storage conditions the seed deteriorates so rapidly that after the first year it will seldom germinate.

A comprehensive study is now under way in the Northeast to determine how to decrease the losses in plantations established on poor soils or under difficult circumstances. The study is of particular importance in view of the large reforestation programs planned or inaugurated in the region by many public and private agencies. In the Lake States measures to prevent the failure of plantations in consequence of the competition of sprouts or brush of aggressive species were studied through liberation cuttings to remove a certain amount of the competing cover.

Although much planting must be done if idle acres are to be made productive or watersheds are to have adequate protection, most of our forest lands will be maintained in productivity through cutting done in such a way as to insure natural reforestation of the right species of trees, in adequate amounts. Studies relating to this are under way in every forest region, and in most of the important forest types of the country. Both these and other studies are conducted, if possible, on experimental forests set aside from the national forests for research purposes. Of these, 9 were established during the year, making 17 in all. Where there are no national forests, forest-management research is considerably handicapped. Private forest owners, however keen their interest, may not be able to furnish the requisite protection to areas on which experiments have been inaugurated; repeatedly sample plots on which much time and effort have been expended have been wiped out by fire. Most forest experiments must be continued over a long period and should be located where their continuity is not exposed to the vicissitudes which changes in land ownership, or in the plans of owners respecting their property, may at any time bring about.

The necessity of measures to assure proper conditions for seedling establishment was particularly exemplified in the northern Rocky Mountain region, where investigations showed that on land which had been cut clear and burned over, the summer temperature and moisture conditions differed so greatly from those in the forest as to make seedling survival most difficult unless the forest is only partly cut.

In the Appalachian region a brush cover largely of worthless species often suppresses desirable species after a cutting. The valuable yellow poplar suffers particularly, apparently succumbing to the combined effect of shade and competition for moisture. What can be done through release cuttings or weeding remains to be worked out. In general, the question of the conditions under which release cuttings, soil cultivation, and similar measures of assistance to nature in reestablishing forests of high quality are economically practicable is as yet almost wholly undetermined. In some types of forest good results can perhaps be obtained through the judicious grazing of livestock, or carefully controlled use of fire on limited areas. Both possibilities should have careful investigation.

Forest-fire studies relate to the behavior of fire, fire control, and fire damage. In the study of fire behavior progress was made in the development of criteria of fire danger. These integrate the dryness of the forest fuels, or combustible materials present at any given time, with the atmospheric conditions such as relative humidity, rate of evaporation, temperature, wind velocity, and days since the last rain. In the northern Rocky Mountain region a fire-danger meter was devised which enables the local forest officer to check his judgment with the aid of a few easily obtained weather data. In the Northeast a quick determination of the hazard is possible by consulting an alignment chart that integrates the principal variables.

Fire-control investigations are concerned principally with the problems of the national forests. They included analyses of the records of past fires to discover weak points in the provisions for control and how better results can be obtained. Previous work on the speed of attack necessary in different forest types to catch fires while they are still small enough to be readily controlled was carried further through study of the allowable time limit between the start of a fire and its detection by the lookouts, and of means of assuring the necessary promptness of discovery on their part.

Study of the records of several thousand lightning storms in the Pacific Northwest indicated that lightning fires are set by two distinct kinds of storms, one of which advances across the country, as a general storm, while the other is a local storm of the conventional type. The Weather Bureau is now study-

ing these storms to determine whether their path can be foretold and their occurrence predicted.

Fire-damage studies continue to show that not all the damage is done at the time of the fire, or is evident in the first year following. In the Appalachian hardwood region it was found that after a fire the death losses directly resulting continued to occur for five years at a rate in excess of the increment through growth, and that species long thought to have a fairly high resistance to fire succumbed.

Investigations of naval stores production in the Southeast showed higher yields from the French method of working the faces than from the American for the first three years of work, but this advantage was apparently lost during the fourth season. Improvements in the methods of hanging cups and of chipping the trees were brought to a point which shows promise for their commercial application. Study for several years of the daily yield of gum from a group of trees disclosed a relationship between the yield and the air temperature, which points to the likelihood that with more frequent gum collections in midsummer clearer rosin and more turpentine would be obtained. It also suggests that more frequent chipping, limited to the summer, might yield as much as does the less frequent chipping during the whole year.

EROSION-STREAM-FLOW INVESTIGATIONS

A series of extensive erosion surveys made during the year disclosed that far more damage is being done on some of our major stream basins than had previously been suspected. Tremendous gullying is taking place on such great watersheds as the Rio Grande, the Colorado, the Mississippi, not to mention lesser basins, with menace to irrigation and flood-control works and great damage to other property. On the Rio Grande watershed in New Mexico it was found that erosion has been greatly accelerated since the arrival of white men, and in specific instances the acceleration can be traced directly to overgrazing, destructive lumbering, or fires. Thirty-five per cent of the area surveyed was seriously eroded, while only 25 per cent could be classed as undisturbed or but slightly eroded. A similar survey of the upper basin of the Colorado River in Utah, Colorado, and Wyoming, where values at stake are far greater, showed that only 23 per cent of the area remains as yet little affected by erosion. Gullies from 10 to 40 feet deep and often several hundred feet wide have been cut through former flood plains, lowering the water table, decreasing productive values of the valley lands, making it much more difficult to take water from streams for irrigation, and doing serious damage to highways, railroads, and other improvements.

In the upper Mississippi River region, especially in the unglaciated region and loessal region, widespread erosion was found to be destroying the most valuable agricultural lands in the region and rapidly getting to a stage where large sums will have to be expended in its control. On the lower Mississippi the studies under way indicate that in the loessal bluff lands costly measures of erosion control are not necessary, save for the very largest gullies. The smaller washes can as a rule be controlled by reforestation measures.

Further study was made of the torrential floods of northern Utah referred to in last year's report. That floods such as occurred in northern Utah in 1923, 1930, and 1931 are a new phenomenon, not a continuation of the processes of undisturbed nature, is geologically evidenced by the greatly accelerated rate of stream cutting and volume of deposits. The excavations in stream channels are deeper and the deposits much larger and farther extended into the valley than any previously produced in the many thousands of years since the days of ancient Lake Bonneville. The serious gullying of slopes on which the vegetation has been depleted mainly by overgrazing and burning indicate that the rapid run-off from these critical areas played an important part in the accumulation of heavily silt-laden water into destructive floods.

On the Boise River watershed, in Idaho, intensive studies were continued to determine the degree of grazing use consistent with maximum forage production, the density of plant cover necessary to hold the soil on different slopes and exposures, and the effect livestock have in increasing erosion through disturbance of the soil. The conditions found indicate that a well-stocked bunch-grass type was formerly distributed over much of this watershed. A friable soil texture, high content of organic matter, and large water-holding capacity produced a luxuriant growth of wheatgrass and like plants. Depletion of this vegetative cover through fire, overgrazing, drought, or other factors

duced its ability to control erosion, and the finer, richer soil particles were washed away. The remaining raw, coarse-textured soil, deficient in water-holding capacity and plant nutrients, has favored a less thrifty stand of coarse-seeded weeds and grasses. Where overgrazing has been excessive and the original plant association and surface soil were lost from 30 to 50 years ago the vegetation is characterized by downy brome-grass and other annuals, with few perennials. All of the plants in this extremely eroded soil make a rapid early growth, and by June have produced seed, are drying up, are useless as forage, and constitute a fire hazard; they are then of value only for soil protection, but for that are of only mediocre value, and only if not burned over.

FOREST-PRODUCTS INVESTIGATIONS

The underlying purpose in forest-products research is to contribute to the economic use of our national land resources through forests maintained to provide a useful raw material upon which profitable industries may be sustained and stabilized, with their attendant public benefits. The accomplishments possible and the extent and location of the forests that should be maintained depend upon the market for what the forests can be made to yield. The results of research are essential. They must largely be applied by the varied industrial and commercial interests engaged in the production, fabrication, manufacture, and distribution of forest products, but the ultimate benefits so accrue to labor, the farmer, and the general public.

Most of the research in this field is conducted at or directed from the Forest Products Laboratory, maintained at Madison, Wis., in cooperation with the University of Wisconsin. Progress will be materially aided when the laboratory staff and activities, now largely scattered in a number of buildings in which the university has generously provided such temporary room and facilities as could for the expanding and overflowing work, can be reassembled in the modern, well-equipped, and commodious new laboratory building erected by the Government and nearly ready for occupancy.

WOOD IN CONSTRUCTION AND FABRICATION

One of the greatest sources of weakness in timber construction is in the joints and fastenings. The size of members is often controlled by the strength required in the joints, not by the stresses elsewhere. Further progress was made during the year in testing various types of fasteners. A new surface treatment for nails made their resistance to withdrawal from wood two to three times that of plain nails and from 30 to 50 per cent greater than does the cement coating now commonly used. A bulletin was completed covering the results of tests which afford engineers the first dependable working data on bolted joints. In cooperation with the National Committee on Wood Utilization, tests of modern connectors used in Europe to increase the efficiency of bolted joints were continued and extended to additional types. Several show great promise. Increased efficiency of the structure, simplified shop fabrication, and rapid erection are among the advantages offered.

The assembly of a number of small pieces of lumber into a larger member by means of mechanical fasteners or glue promises to afford a wider use of small-dimension material, and the fabrication of wood shapes and sizes that could not be formed from a single timber. The study of arrangements of nailed laminæ was continued. It was found that with the proper technique laminated beams can be made with horizontal joints that will not fail by shear in the joints.

Large solid timbers used in building construction check along their length as they season. Some of the methods used by architects to calculate the resistance of beams to shear call for much larger timbers than are necessary. Practical recommendations based on a series of tests of checked beams will soon be released.

Search for a practicable treatment of wood to reduce shrinking and swelling was continued. Chemicals were found that reduce shrinkage as much as 90 per cent, but they make lumber unduly hygroscopic. Chemicals free from this disadvantage are being sought, as well as ways to change the reactive chemicals into nonhygroscopic forms, after their injection into the wood. Continued study of methods of fireproofing wood sought treatments that are cheap, noncorrosive to metals, nonleaching, and not otherwise objec-

tionable. Several combinations of chemicals give promise of meeting these requirements.

HARVESTING, SELECTION, AND PREPARATION OF WOOD FOR USE

In the interest of profitable forestry and stabilized forest-supported industries there has never been more urgent need for lowered costs through improved mill practices for utilization of low-grade logs and for knowing definitely the kind of logs that yield a profit. Information bearing on the efficient conversion of the stand into sawed products was obtained along each of these lines.

Completion of the study of second-growth shortleaf and loblolly pine brought to a close the selective-logging studies throughout the southern pine region. The results show the comparative cost and value of lumber from trees of different size and quality and the smallest trees that can be handled at a profit. Continued investigations of the relation of growth conditions to wood quality afforded increased knowledge of how to obtain lumber of the highest quality and the greatest net value in the shortest time. A start was made in the second-growth longleaf and slash pine region of the Southeast to determine the diameter limits to which pulpwood and other products should be cut. Back of this project lies the broad objective of working out various methods for the efficient management of pulpwood and turpentine forests. The manuscript of the Naval Stores Handbook was completed. It shows how profits may be increased, wastes reduced, and a sustained yield of oleoresin together with other forest products, obtained.

The design of a practical dipping tank for use in reducing blue stain in lumber was completed and made available to small-mill operators. Progress was made in determining the plant equipment for dimension-stock production from the characteristically scattered, low-quality hardwoods of New England. It was found that a modern type of plant cutting 8,000 feet of finished dimension per day will involve an investment of about \$60,000, and also that packaging the product in 2-strap, paper-wrapped bundles, at a cost of \$2 per thousand feet, pays for itself in reduced handling costs and meets the requirements of the consumer for clean, unmarred surfaces.

The study of various phases of wood seasoning was continued. Additional drying schedules were worked out for wide, clear Douglas fir lumber, and the maximum temperatures which may be safely used in drying beech, birch, and maple small-dimension stock were determined. Work on the portable kiln for small-mill operators was completed and directions for its construction were mailed to more than 100 interested operators. This kiln can be built by the operator for less than \$100, it is as movable as the mill itself, and the results and drying time compare favorably with those for more expensive kilns. A new wood hygrostat employing the swelling and shrinking of a thin strip of wood for the control of the humidity condition in a dry kiln was perfected.

Through an analysis of the principal uses to which common lumber is put and the knowledge of defect characteristics of different species studied in the past, a tentative system of improved grading for softwood lumber was drawn up that should aid the lumber industry to meet better the requirements of consumers. The nation-wide study of the specific gravity of commercial softwood lumber was completed, and the results were prepared for publication. Study of the proper conditions for the storage and handling of lumber was continued, and much useful new information was obtained.

PULP, PAPER, AND CHEMICAL PRODUCTS

One of the principal objectives of the research in pulp and paper is to make the United States self-sufficient in these materials. Last year's imports of pulp and paper had a value of approximately \$250,000,000. Translated into terms of employment, they were the equivalent of full-time jobs for 47,000 American workers, to say nothing of their importance from the standpoint of better forest-land use. Through laboratory research, methods which will increase the efficiency and lower the costs of production are being developed.

Investigations of the pulping of southern woods have fully established the feasibility of diversifying their products, hitherto consisting principally of brown kraft wrapping papers and paper boards. Pulp and paper mills in the

outh are now working toward this diversification. The sulphate pulping method and chlorination bleach previously developed at the Forest Products laboratory and used with loblolly, longleaf, and slash pines were applied during the year to Florida sand pine with very good results, and strong white papers of excellent quality were made. The same procedure is now being tried on shortleaf pine. In addition, a large number of white papers, including book, bond, and newsprint, were made from pine and gum sulphite and ground-wood pulps. Particular attention was given to Douglas fir and to a study of the sulphite pulping of western hemlock. In the latter investigation, pulping schedules were developed that result in marked improvement of the pulp and increase the possibilities for utilizing the tree.

Previous experiments have shown that pulps of improved quality result when soda or ammonia base liquors are used. During the year a basis of recovering these salts was developed. This work has the double objective of extending the sulphite process to more resinous species and of eliminating waste sulphite liquors as a source of stream pollution. A new method was developed for measuring hydration in pulps, based on the effect of pretreatment with tannic acids on pulp freeness. It is being used currently in a systematic study of this phenomenon, and should be of great value in improving the paper-making qualities of wood pulps of all kinds.

Excellent progress was made in the design and installation of special equipment for the experimental paper-making machine, the purpose of which is to obtain the measurement and control of the various operating variables that affect the quality of paper. A study of calender pressures showed the limiting conditions of this operation, beyond which a sacrifice of quality results. Similarly, a relationship was established between the solid fraction or volumetric composition of sheets of paper and such properties as color, opacity, and strength. It appears that these properties can be controlled to a large degree through the wet-pressing procedure. The possibilities of paper-quality control through this agency are promising.

The plastic material made from hydrolyzed wood and furfural, mentioned in last year's report, was further developed by determining the optimum conditions for its preparation. It was found, for instance, that the use of a small amount of chlorine as a catalyst considerably reduced both the pressure and the time required for proper molding. Reduced costs of production offer for this type of plastics promise of an expanded field of use that will include low-priced products.

CHEMICAL AND PHYSICAL PROPERTIES OF WOOD

The successful adaptation of any raw material to its best commercial utilization requires a knowledge of the nature and intimate characteristics of the material itself. For each and every form of use the material must undergo some process of modification, adaptation, or selection; and the greater the knowledge the more satisfactorily can the inherent possibilities of the material be made of service.

Fundamental research directed toward a more complete knowledge of the chemical properties of lignin was continued. In the attempt to isolate lignin unchanged, a combination of time, temperature, and acid concentration was worked out which makes it possible to separate for study a lignin very like that which exists in the wood. This finding has also resulted in a shorter and more accurate analytical method for the determination of lignin. It was found that on a mild heat treatment of wood cellulose a ligninlike material was formed. The "synthetic" lignins thus prepared from hardwood and softwood celluloses had characteristics similar to the natural hardwood and softwood lignins, respectively.

The X-ray study on the growth of the cell in the living trees revealed that cellulose in wood is not fully formed until the cell is about 10 days old. The cellulose from cotton requires about 55 days to reach the same condition. Wood extractives in longleaf and shortleaf pine were found to be distributed in the same general manner as was reported last year for slash pine, although the amounts of extractives were somewhat different in the different species. The results of this study have application in the development of more efficient methods for the pulping of the southern pines.

Fundamental research on the effective cross section of the minute openings in the pit membranes of the wood cell gave information on the effect of

concentrated salt solutions in contact with wood, which may aid materially in developing a practical antishrinkage treatment. Progress was made in the study of mechanical properties of wood, on which but few data are available. Variations in stiffness due to the arrangement of the annual layers of wood and other features of wood structure were observed ranging from 2 to 1 to 11 to 1. These differences have an important bearing on the improvement of timber design and construction, and account for some of the difficulties heretofore encountered in wood use.

The investigation of the strength properties of compression wood, which is an abnormal type of wood formed in leaning trees of all coniferous species, revealed that apparently the high longitudinal shrinkage, lack of stiffness, and certain other strength properties peculiar to this wood are due to the large slope of the spirally inclined fibrils which make up the cell wall.

RANGE INVESTIGATIONS

In the foothills of the San Joaquin Valley in California, where long dry summers make the maintenance of forage growth difficult and improper grazing management has seriously damaged range, timber, and watersheds, successive years of exceptional drought have placed the local grazing industry in an extremely critical and precarious situation. Intensive studies were undertaken last year by the California Forest Experiment Station to determine how these lands should be grazed to make them most useful to the livestock industry while duly safeguarding an important public interest in their water yield and in the prevention of soil erosion. Preliminary results showed an insufficient forage production in the critical early winter period. Following the beginning of the feed-producing winter rains several species of annual plants in favorable situations germinated and started growth in a surprisingly short time—alfalfa, for example, within 72 hours of the first rain—and by early January the root systems of many plants had attained considerable development, but top growth was very slow, perennial grasses and other herbs making but 2 to 3½ inches, and annuals only from 1 to 2 inches.

Determination of the relationships in the Southwest between frequency of watering livestock and damage to young growth of ponderosa pine is making possible use of the range without undue injury to timber reproduction. It was found that, irrespective of whether or not the range forage was depleted, cattle watered only once in three days drank only one-third as much as where water was available at all times and did far greater damage to reproduction; evidently they satisfied their thirst by browsing the succulent new pine shoots.

Possibilities for improving depleted spring ranges in the oak-brush zone of central Utah were disclosed by a series of grazing tests. Where grazing was withheld until several weeks after growth started, grasses practically doubled their density, a 50 per cent increase took place in all vegetation, and the grazing capacity was increased by from 35 to 40 per cent. On the other hand, where grazing began from 10 to 14 days before the range was ready for it, the grazing capacity declined 25 per cent and the total density slightly; but sagebrush more than doubled in density, nearly offsetting what the grasses and more palatable weeds lost. Where grazing was deferred each year until seed maturity, grazing capacity increased 73 per cent, accompanied by a gain in density of approximately 80 per cent; shrubs almost trebled in density, and grasses spread approximately 200 per cent.

A fundamental effect on lamb and wool production of differences in available range and supplemental feed appeared in the course of a survey of range management in two communities in Utah. In one community the available spring forage was approximately three times as plentiful as in the other, the summer ranges had more succulent forage, and four times as much corn was fed to ewes on winter range. Their lamb crops were 94 per cent and 85 per cent, respectively. In the first community the lambs weighed 74.4 pounds September 19, in the second 68.4 pounds October 2.

EXPENDITURES AND RECEIPTS

The expenditures for all purposes during the fiscal year were as follows:

General administration.....		\$355,084.65
Forestry extension.....		133,399.11
Research.....		
Silvical investigations.....	\$592,464.26	
Range investigations.....	137,593.67	
Erosion and streamflow.....	101,049.61	
Forest products.....	690,819.71	
Forest Products Laboratory construction.....	640,868.99	
Forest survey.....	207,094.47	
Forest economics.....	80,168.42	
Forest taxation and insurance studies.....	52,610.07	
Total.....		2,502,669.20
Administration, protection, improvement, reforestation and extension of the national forests:		
Administration—		
Timber use.....	\$648,179.88	
Grazing use.....	939,189.89	
Fish and game protection.....	155,760.59	
Recreation and land use.....	321,729.54	
Examination and administration of power sites for Federal Power Commission.....	22,098.00	
Classification, settlement, and claims.....	105,099.44	
General surveys and maps.....	142,555.67	
Grazing reconnaissance.....	91,232.89	
Timber surveys.....	196,473.58	
Fish and game surveys and plans.....	13,260.34	
Recreational surveys and plans.....	26,296.33	
Subtotal.....		2,661,876.15
Protection—		
Fire prevention and detection.....	2,698,725.28	
Fire suppression.....	4,158,381.26	
Protection against insects and tree diseases.....	377,066.61	
Subtotal.....		7,234,173.15
Improvement and equipment—		
Construction of improvements other than roads, trails, and camp-ground improvements.....	1,059,873.69	
General equipment.....	252,743.56	
Maintenance of improvements other than roads, trails, and camp-ground improvements.....	641,646.70	
Camp-ground improvements.....	75,000.00	
Construction and maintenance of roads and trails—		
10 per cent fund under act of Mar. 4, 1913.....	500,292.60	
Cooperative construction of roads and trails under act of July 11, 1916.....	4,737.16	
Highways within national forests, act of Dec. 20, 1930.....	2,079,930.91	
Forest development roads and trails under act of Nov. 9, 1921.....	2,718,813.44	
Forest highways under act of Nov. 9, 1921.....	9,562,656.08	
Road and trail construction and maintenance from moneys contributed by cooperating agencies under act of June 30, 1914, and other cooperation.....	2,135,365.65	
Contributed from other appropriations.....	1,692,669.79	
Class total (roads).....	18,694,465.63	
Subtotal.....		20,723,729.58
Reforestation—		
Nurseries and tree planting.....	291,899.49	
Extension—		
Land exchanges.....	81,130.25	
Acquisition under act of Mar. 1, 1911, as amended.....	1,757,051.47	
Class total (lands).....	1,838,181.72	
Subtotal.....		2,130,081.21
Total.....		32,749,860.09
Protection and reforestation of other than national forest lands:		
Tree planting in cooperation with States, under act of June 7, 1924.....	102,464.98	
Fire protection in cooperation with States, under act of June 7, 1924.....	2,031,888.04	
Protection of Oregon and California grant lands.....	85,744.22	
Total.....		2,220,097.24
Grand total.....		37,961,110.29

In addition to the expenditure for land extension itemized above in the entries "Land exchanges" and "Acquisition under act of March 1, 1911," national-forest timber having an estimated value of \$193,156 was cut under agreements involving the acquisition of land and timber through exchange. The cash disburse-

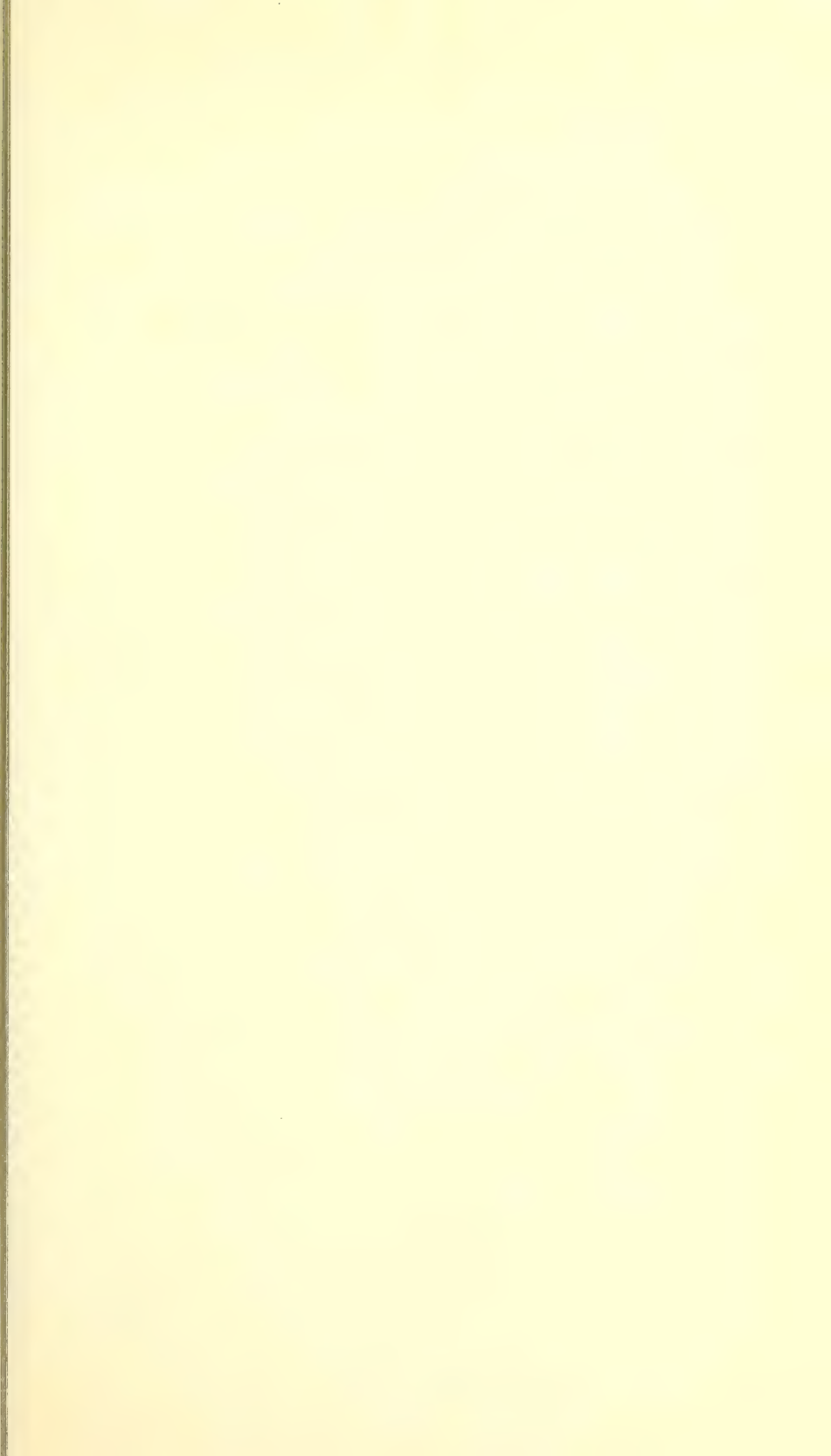
ments recorded under "Land exchanges" cover merely the outlay incidental to examining lands offered for exchange and appraising the values involved.

The cash receipts from the national forests were as follows:

From the use of timber.....	\$1,049,107.8
From the use of forage.....	829,960.1
From miscellaneous uses, including the use of land, water-power sites, etc.....	415,179.6
Total.....	2,294,247.5

The total is less by \$2,699,072.75 than that for the previous year. Receipts from timber decreased \$1,558,510.14, grazing receipts \$1,130,682.20, and miscellaneous receipts \$9,880.41.

In addition to the cash receipts from timber there should be credited the value of the timber cut under specific agreements for effecting land exchanges estimated at \$193,156.



REPORT OF THE FORESTER, 1933

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D.C., September 1, 1933.

SIR: I transmit herewith the report of the Forest Service for the fiscal year ended June 30, 1933.

Respectfully,

ROBERT Y. STUART, *Forester.*

HON. HENRY A. WALLACE,
Secretary of Agriculture.

THE PLACE OF FORESTRY IN PLANNED DEVELOPMENT

Natural resources support our whole economic structure; and land is by far the most important of them. Efficient land use concerns chiefly the use of the soil resources of the country to best advantage. Soil not only serves to grow the products of field, forest, and range but also stores water and controls its movement. Without this regulatory functioning of the soil, water would be a scourge instead of a resource; and without water land is a desert. The satisfactory adjustment of our national economy to the great dual resource of soil and water requires finding the right balance of agriculture, forestry, range use, and water-resource use with each other; and therefore the forest problem of the country is not isolated but is a part of a much greater one, now fast coming to the fore and becoming recognized as a problem of planned development.

That private interest and the public interest in efficient land use tend to coincide has been the generally accepted American theory. The national-forest policy, however, was a striking departure from that theory. Its inauguration led to a large-scale experiment in public control of land use as a means of obtaining a greater aggregate of public benefits than would flow from private ownership. The experiment was begun because the people of the West were deeply concerned for their vitally important water supplies. National-forest administration established control of the private use of the land for lumbering and grazing, and so safeguarded the water values as well as the value of the land for timber and forage production. The Forest Service soon had to find a principle to govern the use of land valuable for more than one purpose.

The principle decided on was that if a choice must be made between conflicting forms of use, the one which will make the land of greatest public utility must be provided for; but that if multiple-purpose use is feasible a plan for coordinated use must be worked out, so contrived as to yield the largest net total of public benefits. This planned and coordinated resource use has in view not only economic but also social welfare. The objective is stated in another fundamental principle that the national forests must be made to serve the greatest good of the greatest number, in the long run.

The national-forest experiment in public control of forest-land use has been on a large enough scale and long enough continued to furnish a thorough try-out. The results obtained have been highly satisfactory to the public. To abolish the national forests and allow private ownership of their resources would be out of the question. Public opinion would not permit it, because the national forests have demonstrated how much it is to the public advantage to have land uses rationally coordinated. And it is through demonstration of the workability of the principle of multiple use that the national-forest experiment has perhaps had its greatest value.

While the scope of this experiment in public control of land use has been extensive, it has also been limited—partly fortuitously, partly on the basis of the character of the land and its resources. The national forests contain about 15 percent of the commercial-forest area of the continental United States, and about 30 percent of the forest land which will not grow timber of commercial quantity and quality. The latter includes lands of scrubby or very inaccessible forest growths and brush lands, important for watershed protection. In all, forest land makes up approximately 77 percent of the national-forest net area—that is, the area owned by the Government—in the continental United States. Most of the remaining 23 percent is in broken or scattered areas incidentally included because of their location. Some of it is bare rock, but in the main it has value both for grazing and for the control of water flows and erosion. The present extent of the national forests west of the Great Plains roughly represents the outcome of a gradual but still incomplete process of setting aside from private acquisition or the operation of State grants the unalienated forest lands of the public domain. The western national forest lands, however, also include a small percentage of lands that have been reacquired after alienation, through exchange. The eastern national forests are in the main the result of a gradual process of upbuilding through land purchases, as appropriations for the purpose permitted. Neither in the West nor in the East, therefore, do the national forests represent the outcome of a completed job consistently followed through, to substitute public control of forest-land use for *laissez faire* on any logical basis of distinction between lands desirable and lands undesirable for public administration. Instead, public ownership owes its present set-up largely to accident—in the West, to the accident of the particular lands which happened to be available for reservation; in the East, to the accident of the appropriation which happened to be thought expedient from year to year.

It has suddenly become widely believed that large-scale national planning must be undertaken quickly in the interest of a better ordered and better balanced economic and social development than *laissez-faire* individualism has been leading to. New public policies are being entered upon, and new experiments in public control and direction of the Nation's economic life are being set up. A far-reaching consideration of the possibilities of better resource use is taking place.

The practical urgencies of the immediate economic situation place in the forefront the problems of agriculture. Closely related with the problem of surplus agricultural land is that of idle cut-over land, much of which is plowable. Its cheapness and the anxiety of its owners to develop a market for it tend to induce an expansion of agriculture along lines similar to those which have already been largely responsible for the great number of submarginal farms. The depression has caused a back-flow of population from industrial centers to the rural regions, and this may readily lead to further clearing and settlement of land submarginal for agriculture. To bring the production of agricultural crops into balance with the demand for these crops calls for diminishing the acreage devoted to most of the major farm products. In the long run this must be brought about through a better balanced land use than unplanned development gives any promise of effecting without prolonged hardship and immense losses. Were nothing else involved, the problem of agricultural readjustment alone would necessitate a restudy of the problem of forest-land use and a more logical set-up for public forest ownership as a means of working out both problems.

But more than agricultural readjustment is involved. The Federal Government has entered upon another great experiment in planned resource development and use, more comprehensive than the national-forest experiment. The Tennessee Valley Authority has undertaken the upbuilding of the whole economic and social structure of a great region, through wise and farsighted planning for the best use of its soil, water, mineral, and human resources in a combined pattern that will aim at affording the most favorable conditions of life for all its people; in other words, at our national-forest aim of the greatest good for the greatest number in the long run. The forest resource must and undoubtedly will have a place in this planning commensurate with its regional importance. And that is very large. Permanent forests are essential for the region not only to supply wood for industrial and other uses, not only to make land productive which is not capable of affording the farmer a good living, but also to protect the watersheds, hold in check erosion, shelter and support wild life, add to recreational opportunities, make the whole countryside more habitable, heighten the beauty of the mountain landscapes, and enrich the common life. To bring about the necessary coordination of these multiple forest uses, extensive public acquisition and

administration of the forest lands of the basin will unquestionably be required as part of the general plan. Preparations for initiating this have already been begun by the Authority, which has set up within its organization an agency for the purpose.

THE COPELAND REPORT

A better basis for planning the measures necessary to efficient use of the forest resource in the interest of the common welfare than has ever before been available was provided by the restudy of the whole forest situation made by the Forest Service during the year, in compliance with the so-called "Copeland resolution" of the United States Senate. The resolution, adopted March 10, 1932, requested the Secretary of Agriculture to advise the Senate as to the desirability of Federal aid to the States "in the utilization for forestation purposes of those areas in the United States suitable for forestation only", with a full statement of the reasons for the course proposed and of the supporting facts. This struck deep into the whole question of public forest policy and the coordinated Federal and State action necessary to advance the general welfare most effectively. The answering report, A National Plan for American Forestry, was transmitted to the Senate March 27, 1933. It embodied the results of the most comprehensive and exhaustive survey of the entire field possible within the time and with the resources available. In transmitting it, the Secretary of Agriculture fully endorsed and recommended the earliest possible action on the Federal part of the plan. The situation disclosed by this study seems to leave no doubt of the necessity for recasting the public programs.

Hitherto private owners of forests have sought, with rare exceptions, not permanency of forest use but exploitation of the standing timber values. Out of nearly 400,000,000 acres of commercial timber-growing land in private ownership, of which 270,000,000 acres is in industrial holdings, less than 25,000,000 is under some degree of forest management. Overdevelopment of the lumber industry, largely due to too heavy investment in forest land for the sake of the present stand of timber, increases the instability of private ownership and the pressure to liquidate—to "cut out and get out." Cut-over lands which the owner has no further incentive to hold are a burden to be unloaded, either through agricultural development or through abandonment to public ownership. Few States are willing to assume the burden. Instead, the usual course is to try to pass abandoned lands back into private ownership so that they will again be a source of tax revenues. The overwhelmingly major trend in private forest-land ownership is toward progressive deterioration in the character of the forest, the value of the stand, the replacement through growth, and the productive capacity of the property. Less than 4 percent of the nearly 9,900,000 acres of private land cut over annually is cut over with regard for future yields, and more than 800,000 acres of private forest land is added annually to the already more than 83,000,000 acres so poorly stocked that it must be classed as devastated. Millions of acres of forest land have passed from private into forced public ownership through tax forfeiture, millions more are tax-delinquent and on the way to forfeiture, and other millions are steadily working nearer the time when their owners will no longer think them worth paying taxes on. Temporary forest ownership brought about in order to obtain and remove the standing timber is extensively breaking down.

This of course is not the whole picture. It is very far from being true that a universal breakdown of private forest ownership is in prospect and that if there is to be extensive forest perpetuation and forest management for timber growing, they will all have to be as a public undertaking. Aside from the 125,000,000 acres of commercial farm woodlands, the great bulk of which can be classed as in a stable form of ownership, the Copeland report estimates that as much as 150,000,000 acres of private forests may still be in condition to afford promise of suitability for permanent private timber-growing enterprises. This amount may even be increased through private reforestation of some of the land on which there is now little or no restocking. Sound economic planning for the forest resource should give a large place to private ownership, and by every suitable means reversal of the drift toward abandonment should be attempted. It must nevertheless be recognized that a very large part of the forest land now privately owned has become so depleted of valuable timber and must wait so long before the forest capital necessary to afford a satisfactory income can be built up again, that only through public ownership can its restoration to a productive condition be looked for.

The "national plan for American forestry" proposed in the Copeland report calls for aggressive measures both to promote private forestry and to build up

public forests. With respect to the latter it recommends the immediate inauguration of Federal and State acquisition programs looking to the eventual public ownership of approximately 395,000,000 acres out of a total of 670,000,000 acres of commercial and noncommercial forest land, including some 55,000,000 acres of abandoned agricultural land. This requires a public-acquisition program for a total of 224,000,000 acres, much of which will be tax-reverting lands and which in the main would be of the same general type that makes up the bulk of the State and Federal acquisition now going on; that is, lands on which there is little valuable timber at the present time and which afford little prospect of future productiveness except through their public administration with multiple use in view. The State share in this program, it is believed, cannot reasonably be put at more than 90,000,000 acres. This leaves for the Federal share 134,000,000 acres. The Copeland report advocates a 20-year acquisition program to accomplish this, accompanied by an expansion of aid to the States in fire protection and other means of promoting both private and public forestry, and adequate Federal provision for the care and development of its own holdings and for the research basic to both private and public forestry practice.

The Copeland report dealt also with the possibility of stimulating the practice of forestry on privately owned lands through cooperative arrangements with the forest industries, under which their lands would be put under continuous forest production. The public would cooperate by permitting the industries to curtail output, by suitable arrangements for publicly sponsored loans adapted to the requirements of the forestry enterprise, and by other measures of assistance. Thus private owners and the public might work together on an equitable basis to obtain results in which both are vitally interested. It was recommended that an attempt be made to work out such arrangements at an early date.

When the National Industrial Recovery Act was in process of formulation the Forest Service recommended to the Secretary of Agriculture that its provisions be so shaped as to permit carrying out this plan. The act includes specific provision for the conservation of natural resources. After it was passed the President communicated to the representatives of the lumber industry, through the Secretary of Agriculture, a personal message informing them that "he trusts any code relating to the cutting of timber will contain some definite provision for the control of destructive exploitation."

A conservation article is included in the lumber code as approved by the President on August 19. Article I of the code states as one of its purposes "to conserve forest resources and bring about the sustained production thereof." Article X, the conservation article, further commits the lumber industry to the principle of the conservation and sustained production of forest resources. It provides that the applicant industries "shall forthwith request a conference with the Secretary of Agriculture and such State and other public and other agencies as he may designate." One purpose of the conference is to initiate the working out of the detailed provisions which shall govern the industries in carrying out the purpose of the code as to conservation and the commitments of the industry. Another purpose is to determine what cooperation of Federal, State, or other public agencies may be necessary.

Action has also been initiated by the Department looking to the adoption of practices of conservation for other classes of forest holdings. The codes now being formulated by the pulp and paper and the naval stores industries, for example, will presumably include provisions to this end.

THE ADVANCE BEGUN

The President's emergency conservation work, together with the public-work program and provision for accelerated land acquisition, has permitted a start toward meeting some of the objectives of the national plan for American forestry.

The emergency conservation work originated in the national need for unemployment relief and for counteracting its destructive effects on the manhood of those in their early working years. Of the 300,000 men enrolled in the Civilian Conservation Corps, by far the greater part were from the larger cities. Most of them had never seen the woods. Idle and undernourished as a result of conditions over which they had no control, at the outset they were incapable of normal sustained physical effort. Discouraged, their morale was low.

Visualizing these facts, the director of emergency conservation work formulated plans for execution by the Army to assure that the men enrolled should be given a preliminary period of physical conditioning and that they should have

special living and working conditions, medical care, and suitable food and recreation. The results in man-building have been phenomenal.

Woods work played its part in this development—work which is helping to put forest properties in condition to support other men year after year. The volume of woods accomplishment, in addition to what has been done in attaining the major objectives of relief and rehabilitation, is truly impressive. Most of it is work long planned by Federal and State forestry agencies for orderly accomplishment over the years.

For the Forest Service the first step toward getting the work under way was to select thousands of these previously planned projects, scattered throughout the most inaccessible portions of the United States, Alaska, and Puerto Rico, that would be suitable in character and location for being conducted from 200-man camps of inexperienced youths often actually working from 4 to 5 rather than 8 hours per day, and to select suitable camp locations. There was also the task of determining the kinds and quantities of tools, machines, trucks, and the like which should be provided for each project, and of procuring and distributing this equipment. Suitable supervisory men, with knowledge of the various jobs (many of which were highly specialized) as well as ability to lead, were recruited, instructed, and assigned. After the camps were established, the Forest Service took over each morning from the Army officers at the camps full charge of the enrolled men, to teach, encourage, and supervise them and then turn them back again to the Army in the afternoon. During the first 6 months there have been 97 camps located on the national forests. The Forest Service was also called upon to recommend for or against all projects on State and private lands (excepting State parks) in 47 States and to supervise and assist State authorities in the conduct of all work being done from the 660 camps established on these State and private lands.

After the close of the fiscal year \$40,000,000 was allotted the Forest Service for road, trail, and improvement construction and maintenance as a part of the public-works program to provide employment and stimulate recovery. Here also the projects to be undertaken are projects called for under general development plans already made. Where camps are necessary they will be located directly on the various jobs, with each crew of the size that is best suited to the specific job on which it is working. Men are employed who are experienced, physically fit, and able to work 8 hours a day, for wages which offer a full incentive. There is, therefore, every reason to expect an output per man-day, week, or month which meets in every way the high standards previously set for similar work on the national forests.

An immense further impetus was given toward the achievement of the long-time objectives of the Federal forest policy when, on May 20, the President allotted by an Executive order \$20,000,000 for resuming and accelerating the acquisition of lands in the East for national-forest purposes. This is further discussed in the section of this report on the National Forest Properties.

PROGRESS IN BUSINESS METHODS AND ORGANIZATION

The Forest Service continued its unrelenting effort to improve its business practices and organization. Over a long period of years painstaking study has been directed toward finding out how effort can be better organized, objectives better selected and more clearly defined, business and technical methods improved, procedure simplified, responsibilities fixed, output increased, and costs cut down. In the field of executive management these studies have produced results recognized by outside experts in the subject as going beyond the best that private business has worked out. Through rigorous analyses of the time requirements of each job it has been possible to apportion the loads carried more evenly and thus reduce the working force necessary. Accounting methods have been bettered and financial control facilitated. More work and better work has been done by fewer people. The tightening-up process in the effort toward greater efficiency and economy has had cumulative results. The Forest Service welcomes comparison with any private enterprise in its organization and business system.

The cost-accounting system now operative in the Service, as briefly described in former reports, was adopted July 1, 1931. Installation has been accomplished on schedule. All units of the Service, comprising 188 national forests, nurseries, experiment stations, and regional offices, operated under the new system classification of expenditures during the fiscal year 1932 and completed the set-up of

investment and depreciation records during the year 1933. Results so far obtained have proved the system to be productive of reliable data and capable of meeting all demands for special or detailed cost information required for administrative decisions. During the latter part of the year, when the Forest Service was called upon to cooperate with other departments and bureaus in the colossal undertaking of placing 300,000 workers in forestry camps as a part of the President's emergency work program, the system proved capable of absorbing the increased volume of accounting detail without alteration.

The complete system becomes fully operative with the beginning of the fiscal year 1934. Built as it is upon advanced accounting theory and practice, it places the Forest Service in a rather unique status and more nearly in line with private industry in cost-finding practice. Its inauguration marks a decided forward step in cost control of governmental expenditures.

Despite the greater detail and completeness of cost information obtained under the new system, as compared with the system discarded at the close of the fiscal year 1931, its installation and development has been accomplished without addition to the clerical staff and with practically no additional costs.

DECENTRALIZATION OF ACCOUNTING, WAREHOUSING, AND PURCHASING FUNCTIONS

The nature of the Forest Service work is such as to require decentralization of the administrative organization in order to accomplish prompt action and permit direction of the work by officers thoroughly familiar with local and regional conditions, leaving to the central office the determination of broad policies and general direction of the work, with sufficient flexibility to prevent undue interference with accomplishment under varying conditions. In an organization of this type much of the related overhead functions can be most efficiently and economically handled if also decentralized. The centralization of portions of the accounting work has been attempted in the past, both in Washington and in the regional offices, and it was evident that instead of improving accuracy or reducing cost its effect was just the opposite. The centralization did not relieve the local organizations to any appreciable extent and resulted in no reduction of personnel, while it did add materially to the work of the central or regional organization. In the decentralized handling of accounting work it has been the aim to reduce duplication to the minimum, the detailed records being maintained in the local office only, while the records of the regional and Washington offices are confined to those necessary to permit effective fund control and to maintain all-Service records of the summarized data currently compiled by the field offices.

Similarly the decentralization of the warehousing function in large measure dependent upon the local conditions as to labor supply, transportation facilities et cetera, is necessary to effective action at reasonable cost. It is highly essential to have available locally or within working distance all tools, equipment, and supplies required for the suppression of forest fires. Often these can be most readily distributed from the place at which the crews are assembled. In some instances a centralized regional warehouse is effective; under other conditions it is not practicable. It has been the constant aim to devise for each forest or section the most economical and effective arrangement for the existing conditions. While promptness in organizing and equipping crews other than fire is not of the same urgency, usually the same distribution of warehouses is suitable for all field work in the locality.

The degree to which economy is served through centralization of purchasing varies widely. In some cases purchase from the General Supply Committee schedule is most economical. At times it has been possible to obtain, through independent competitive bids, much lower prices than those on the schedule for definite large quantities needed at one point or procured for shipment to one regional distributing point. Some local purchasing is unavoidable. It is invariably the practice in the Forest Service to utilize the most economical means of procurement which calls for centralized or grouped purchasing in obtaining large quantities and in procurement of special equipment or supplies requiring special packing or processing to meet the requirements of the Service. Ordinarily the farther removed the procuring agency is from the consuming agency the greater is the overhead and intervening expense, which must be offset against the better prices obtainable on quantity purchases in determining which channel of procurement is in the end the most economical.

LEGISLATION OF THE YEAR

The acts making appropriations were:

The act of March 3, 1933 (47 Stat. 1432), making appropriations for the Department of Agriculture for the fiscal year 1934.

The act of June 16, 1933 (Public, No. 77, 73d Cong.), which is the Fourth Deficiency Appropriation Act for the fiscal year 1933. It appropriated \$3,300,000,000 for expenditure under the Industrial Recovery Act of June 16, 1933 (Public, No. 67, 73d Cong.), and the Relief of Unemployment Act of March 31, 1933 (Public, No. 5, 73d Cong.). Not to exceed \$50,000,000 of the amount appropriated was made available to the Directors of the Tennessee Valley Authority. This appropriation of \$3,300,000,000 is to remain available until June 30, 1935.

The following acts relating to personnel and reorganization were passed:

The act of March 3, 1933 (47 Stat. 1489), which authorizes the President to reorganize the Executive Departments, and extends for the fiscal year 1934 the economy provisions of the Legislative Appropriation Act for the fiscal year 1933 (47 Stat. 399); see also Reorganization of Executive Departments, title 3, act of March 20, 1933 (Public No. 2, 73d Cong.).

The act of March 20, 1933 (Public, No. 2, 73d Cong.), which contains various provisions relating to the compensation of Federal officers and employees. This is the so-called "Economy Act."

The act of June 16, 1933 (Public, No. 78, 73d Cong.), the Independent Offices Appropriation Act, 1934, containing items relating to the retirement of civil employees having had a period of service of at least 30 years, and also authorizing furloughs.

The acts making or authorizing additions to national forests were:

The act of March 4, 1933 (47 Stat. 1569), which added approximately 123,830 acres to the Gunnison National Forest, Colo.

The act of March 4, 1933 (47 Stat. 1563), which authorized the addition of 640 acres to the Modoc National Forest by exchange.

The legislation relating to national forest administration comprised:

The act of January 19, 1933 (47 Stat. 771), which amends the United States mining laws applicable to lands within the Prescott National Forest, Ariz., from which the city of Prescott obtains its water supply, and prevents the acquisition of title to the surface of these lands under the mineral-land laws.

The act of June 13, 1933 (Public, No. 42, 73d Cong.), which authorized the President to create a game refuge within the Ouachita National Forest in Arkansas.

The act of March 31, 1933 (Public, No. 5, 73d Cong.), the Unemployment Relief Act, under authority of which conservation camps are established.

The act of May 18, 1933 (Public, No. 17, 73d Cong.), which authorized the development of Muscle Shoals and the Tennessee Valley.

The act of June 16, 1933 (Public, No. 67, 73d Cong.), the Industrial Recovery Act, which contains provisions relating to public construction.

The act of May 31, 1933 (Public, No. 28, 73d Cong.), authorizing the Secretary of Agriculture to segregate lands within the Carson National Forest for the benefit of Pueblo de Taos Indians of New Mexico.

PROGRESS IN STATE-FORESTRY LEGISLATION

North Dakota and Texas passed laws authorizing Federal land acquisition for national-forest purposes. Alabama altered the limitation under which Federal acquisition was restricted to lands within the Alabama national forest boundaries, to permit purchases in the Tennessee Valley; Missouri increased the maximum which might be acquired in any one county from 2,000 to 25,000 acres; Wisconsin increased the maximum for the entire State from 1,000,000 to 2,000,000 acres; and Tennessee no longer limits purchases to lands within 20 miles of the North Carolina State line.

Connecticut authorized the State forester to acquire land adjoining a State forest by exchanging for it the right to cut and remove from State forest land, within a period which may not exceed 10 years and subject to regulations prescribed by the State forester and under his supervision, forest products equal in value to that of the land. Florida authorized the board of forestry to recommend lands suitable for reforestation projects, State forests, and State parks, and to administer them when dedicated to this use by the trustees of the internal improvement fund.

Minnesota created 13 new State forests, and authorized acquisition of lands within them by gift, purchase, or condemnation. Purchase funds were made available out of the income from State forests and moneys of the Department of Conservation, of which a portion was allotted for the purchase of game refuges and public shooting grounds. Another law created a State forest fund and provided for payment of one half of the gross receipts from each forest to the county in which it is located. A newly created land-use committee in Minnesota is to classify all public and private lands in the State, principally with respect to their adaptability to present known uses such as agriculture and forestry, and report the results to the State legislature, with recommendations.

Montana authorized State land exchanges with counties, and New Hampshire authorized purchase by the State Forestry Commission, with the consent of the Governor and Council, of lands for State forests and reservations. Purchase money had previously to be supplied from private sources. Under supervision of

the commission, the State forester was given complete authority over the use of State forests and reservations, including reservations for public recreational and park purposes.

Ohio empowered municipal corporations to acquire by purchase, lease, or condemnation land for forest reserves. Oregon amended the so-called acquisition law, making it possible for county courts to transfer title to the State without an abstract. West Virginia created a public-land corporation, consisting of the governor and four other members, in which is vested the title to State lands acquired or which may be acquired through title forfeiture. The State corporation is to designate the use of the lands, and is to transfer or allot them to the appropriate State agencies, if their administration by the State is called for. Tennessee empowered the governor to set apart and reserve for State forests suitable State-owned lands, including lands which have become or may become tax-reverted, surface rights to lands held primarily for minerals, and any donated lands.

Colorado abolished the State board of forestry and the office of State forester and imposed all their powers and duties upon the State board of land commissioners.

Various States amended their fire laws. Nevada's 1931 law providing for Federal and State cooperation in forest fire prevention and suppression was strengthened by creating a special fund, to be used solely for protecting forest and watershed areas, subject to the approval of the surveyor-general. In Oregon the State forester now has authority to waive the slash-disposal requirement where burning the slash would create a further fire menace. A new Oregon law provides for a modified form of closure, corresponding closely to the Federal regulations dealing with entry into hazardous areas; the forester or a warden may now require entrants to have a permit for camping outside designated areas, to refrain from smoking, and to carry certain tools. This can be applied to areas where the hazard does not necessitate a complete closure. Rhode Island, Vermont, Washington, and West Virginia also added to their forest-fire legislation.

California provided that all State nursery stock must be sold for not less than the cost of production. Washington empowered the State forest board to use the forest-development fund to purchase land for growing timber. Previously this fund could be used only to pay interest and principal on bonds issued by the board for the purchase of cut-over lands. The board was also authorized, in order to carry on a reforestation program insuring a continuous timber supply, to block up areas located within counties where timber grows rapidly, and to purchase delinquent-tax lands from counties. Another Washington law set aside a block of State land on which the timber must be handled on a sustained-yield basis, the expenses of administration to be taken out of the gross proceeds.

Maine repealed the yield tax law, originally enacted in 1921 and completely revised and strengthened in 1929. Forest owners had made little use of the law until recently; but when changed economic conditions caused them to take advantage of its terms, the towns whose revenues were seriously affected insisted on its repeal. Minnesota extended the period of redemption of lands sold for taxes from 5 to 7 years, thereby preventing the law under which the State would have taken over title to several million acres of tax-delinquent lands in 1933 from taking effect for another 2 years.

An amendment to the New Mexico constitution authorizing the exchange of State lands in the national forests for Federal lands of equal value was submitted to the electors and carried at the general election in 1932. A Minnesota constitutional amendment authorizing the exchange of public lands of the State "for lands of the United States and other privately owned lands as the legislature may provide" will be submitted to the electors at the general election in 1934. An amendment similar except that it did not include "other privately owned lands" (mentioned in the annual report for 1931) was lost at the last general election, November 1932.

Laws specifically directing that forest work be made to afford employment to a maximum number of unemployed or partially employed citizens of the States were enacted by several States. Alabama authorized the State Forestry Commission to make rules and regulations covering the forests within the respective counties of the State in order to comply with the Reconstruction Finance Corporation's requirements in lending money for the preservation and reforestation of the forests of the county. Florida provided for the formation of limited dividend corporations which may secure funds from the same corporation for the protection and development of forests and other renewable natural resources. Minnesota, South Carolina, Tennessee, and Washington enacted legislation

ermitting the borrowing of money for the promotion of reforestation and providing work for the unemployed. New Hampshire appropriated \$100,000 for the fiscal year 1933-34, and a like amount for the following year, to be expended by the forestry department for improvement work on State and private lands as an unemployment-relief measure. The issuance of bonds to cover the amount appropriated was authorized.

WORK OF THE YEAR IN STATE COOPERATION

Federal appropriations for cooperative work with the States during the year, as compared with those in 1932 and 1934, are shown in table 1.

TABLE 1.—*Appropriations for State cooperation, 1932-34*

Item	Amount appropriated for fiscal year—		
	1932	1933	1934
for the prevention and suppression of forest fires, and for the forest-taxation inquiry and the insurance study (secs. 1-3 of the Clarke-McNary law).....	\$1, 775, 000	\$1, 611, 580	\$1, 190, 635
for the distribution of forest planting stock to farmers (sec. 4 of the same law).....	95, 000	79, 960	56, 053
for farm-forestry extension (sec. 5 of the law, administered by the office of cooperative extension work).....	74, 000	69, 850	50, 240

¹ The item of the appropriation act was \$1,661,580. This was reduced by an administrative cut of \$50,000.

² The item of the appropriation act was \$1,587,513. It was administratively cut by \$396,878.

³ The item of the appropriation act was \$74,736. The administrative cut was \$18,683.

⁴ The item of the appropriation act was \$64,787. The administrative cut was \$14,547.

The results of the work are summarized in table 2, except those of the taxation study and the insurance inquiry, which appear on pages 36 and 37. Table 2 shows in detail the Federal, State, and private funds disbursed by the States or expended under their supervision for the prevention and suppression of forest fires, and the Federal and State funds disbursed by the States for the production and distribution of planting stock.

TABLE 2.—*Cooperative expenditures for fire protection and for the distribution of forest planting stock under the Clarke-McNary Act, fiscal year 1933*

State	For fire protection				For the distribution of forest planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Alabama.....	\$32, 016. 93	\$11, 736. 85	\$20, 280. 13	\$64, 033. 91	\$531. 81	\$531. 80	\$1, 063. 61
California.....	173, 406. 00	201, 139. 31	169, 275. 63	543, 820. 94	317. 59	317. 58	635. 17
Colorado.....					1, 493. 01	1, 493. 01	2, 986. 02
Connecticut.....	13, 603. 00	55, 261. 61	1, 592. 54	70, 457. 15	2, 000. 00	2, 287. 04	4, 287. 04
Delaware.....	2, 224. 00	3, 641. 10		5, 865. 10	1, 400. 00	1, 531. 95	2, 931. 95
Florida.....	66, 901. 29	37, 933. 12	29, 759. 36	134, 593. 77	1, 781. 89	1, 781. 89	3, 563. 78
Georgia.....	39, 057. 65	17, 862. 90	21, 194. 76	78, 115. 31	2, 000. 00	2, 408. 65	4, 408. 65
Hawaii.....	444. 00	2, 036. 64		2, 480. 64	2, 750. 00	8, 687. 24	11, 437. 24
Iaho.....	66, 061. 00	35, 374. 09	78, 251. 73	179, 686. 82	928. 00	1, 017. 08	1, 945. 08
Indiana.....	6, 894. 00	7, 744. 14		14, 638. 14	2, 350. 00	17, 687. 26	20, 037. 26
Iowa.....					2, 000. 00	2, 312. 68	4, 312. 68
Kansas.....					1, 480. 25	1, 480. 25	2, 960. 50
Kentucky.....	4, 737. 77	4, 737. 77		9, 475. 54	1, 406. 00	2, 357. 68	3, 763. 68
Louisiana.....	47, 046. 00	32, 811. 97	26, 244. 55	106, 102. 52	1, 751. 15	1, 751. 15	3, 502. 30
Maine.....	58, 360. 00	135, 087. 13		193, 447. 13	669. 28	669. 25	1, 338. 53
Maryland.....	12, 149. 00	38, 309. 83	301. 94	50, 760. 77	2, 000. 00	3, 563. 63	5, 563. 63
Massachusetts.....	32, 508. 00	69, 924. 13		102, 432. 13	2, 252. 00	5, 332. 81	7, 584. 81
Michigan.....	119, 871. 00	282, 835. 77		402, 706. 77	2, 148. 00	6, 875. 12	9, 023. 12
Mississippi.....	18, 591. 03	15, 059. 81	3, 531. 30	37, 182. 14	538. 35	538. 37	1, 076. 72
Minnesota.....	95, 081. 00	227, 279. 49		322, 360. 49			
Montana.....	26, 052. 00	13, 817. 88	36, 071. 32	75, 941. 20	2, 000. 00	2, 178. 05	4, 178. 05
Nebraska.....					2, 367. 00	11, 395. 00	13, 762. 00

TABLE 2.—*Cooperative expenditures for fire protection and for the distribution of forest planting stock under the Clarke-McNary Act, fiscal year 1933—Continued*

State	For fire protection				For the distribution of forest planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Nevada.....	\$1,885.00	\$105.00	\$4, 114. 71	\$6, 104. 71			
New Hampshire.....	17, 058. 00	41, 139. 49	5, 202. 83	63, 400. 32	\$2, 255. 00	\$3, 621. 84	\$5, 876. 84
New Jersey.....	24, 977. 00	117, 460. 40		142, 437. 40	2, 605. 00	14, 889. 52	17, 494. 52
New Mexico.....	2, 171. 40	2, 762. 00	2, 620. 00	7, 553. 40			
New York.....	63, 481. 00	242, 740. 68		306, 221. 68	2, 945. 00	17, 591. 50	20, 536. 50
North Carolina.....	36, 564. 37	31, 811. 36	4, 753. 02	73, 128. 75	2, 000. 00	2, 582. 59	4, 582. 59
North Dakota.....					2, 241. 00	7, 334. 15	9, 575. 15
Ohio.....	5, 903. 00	9, 184. 47		15, 087. 47	2, 384. 00	18, 629. 70	21, 013. 70
Oklahoma.....	13, 903. 08	12, 983. 24	919. 90	27, 806. 22	2, 000. 00	3, 328. 38	5, 328. 38
Oregon.....	98, 288. 00	22, 466. 45	115, 680. 43	236, 434. 88	1, 583. 98	1, 584. 00	3, 167. 98
Pennsylvania.....	56, 270. 00	231, 298. 27		287, 568. 27	2, 775. 00	16, 549. 68	19, 324. 68
Puerto Rico.....					2, 185. 00	5, 905. 04	8, 090. 04
Rhode Island.....	1, 733. 00	7, 687. 83	3, 936. 41	13, 357. 24			
South Carolina.....	23, 606. 14	9, 071. 73	14, 608. 11	47, 285. 98	2, 000. 00	2, 737. 45	4, 737. 45
South Dakota.....	847. 00	871. 93		1, 718. 93			
Tennessee.....	19, 600. 01	19, 937. 30	2, 715. 52	42, 252. 83	2, 105. 00	3, 973. 81	6, 078. 81
Texas.....	39, 924. 00	36, 600. 99	10, 638. 00	87, 162. 99			
Utah.....					1, 300. 00	1, 475. 50	2, 775. 50
Vermont.....	6, 112. 00	9, 360. 87	3, 925. 52	19, 398. 39	2, 000. 00	5, 027. 68	7, 027. 68
Virginia.....	32, 129. 00	37, 049. 44	4, 065. 85	73, 244. 29	2, 000. 00	2, 389. 31	4, 389. 31
Washington.....	95, 149. 00	69, 251. 50	67, 154. 98	231, 555. 48	2, 000. 00	2, 217. 20	4, 217. 20
West Virginia.....	26, 810. 00	52, 948. 84	22, 086. 83	101, 845. 67	2, 000. 00	5, 226. 20	7, 226. 20
Wisconsin.....	70, 693. 00	345, 194. 76		415, 887. 76	2, 000. 00	2, 651. 36	4, 651. 36
Wyoming.....					1, 522. 00	2, 079. 06	3, 601. 06
Administration and inspection.....							
Total.....	76, 032. 19			76, 032. 19	3, 031. 97		3, 031. 97
Forest-taxation and insurance study.....	1, 528, 139. 86	2, 492, 520. 09	648, 925. 37	4, 669, 585. 32	77, 097. 28	195, 991. 46	273, 088. 74
Impoundage.....	47, 641. 21						
Unexpended balance.....	12, 299. 63				550. 25		
Total appropriation.....	23, 499. 30				2, 312. 47		
Total appropriation.....	1, 611, 580. 00				79, 960. 00		

COOPERATIVE PROTECTION OF STATE AND PRIVATE FOREST LANDS FROM FIRE

In the calendar year 1932 approximately 223,000,000 acres of State and private forest or potential forest lands were reported by the States as under some form of organized protection from fire. The acreage protected is 53 percent of the total forest area classed as needing protection.

Table 2 shows a total of \$3,141,445.46 State and private funds spent by the States and private owners in cooperative forest fire protection in the fiscal year 1933. The corresponding totals for the fiscal years 1932, 1931, and 1930 were \$4,370,274, \$5,011,421, and \$4,117,652, respectively. The 1933 expenditure were slightly greater than those made in 1929 and 1928.

Thirty-eight States cooperated—the same number as in the previous year. Plans were formulated for adding Arkansas to the group, and the agreement for the project was signed by the State forestry commission on June 13, 1933.

The total area of protected State and private land reported as burned over by forest fires in the calendar year 1932 was 2,904,350 acres (of which 498,970 acres are classed as not having a productive value), as against 5,854,270 acres in 1931 and of unprotected forest lands 38,410,000 acres, as against 45,200,000 acres in 1931.

Within protected units the 2,405,380 acres classed as productive forest land which were reported as burned over constitute 1.1 percent of the forest area protected. It is significant that 93 percent of the State and private land burned over in 1932 was outside of protected units.

The number of fires reported for protected units of State and private land for the calendar year 1932 was 55,575, as against 56,443 in 1931.

COOPERATION WITH STATES IN TREE PLANTING

In the calendar year 1932, 23,500,000 trees were planted in windbreaks, shelter belts, and farm wood lots by farmers, a decrease of approximately 8 percent from the 1931 record. As in the previous year, 38 States, Puerto Rico, and Hawaii engaged in the activity.

That none of these projects was discontinued, despite the sharp reductions in State budgets for all activities, is impressive evidence of the importance of forest planting on farm lands and of the appreciation of its importance by the States.

Federal assistance has been a large stabilizing factor. About 23,500 acres was added to forest plantations on farms by the cooperative effort. Pennsylvania distributed the largest number of trees to farmers, closely followed by New York, which is far in the lead in planting on State land. The States coming next to these two in farm planting are Ohio, Indiana, Nebraska, Michigan, Tennessee, Vermont, Wisconsin, New Jersey, Georgia, South Carolina, and Florida, in the order named.

COOPERATION WITH STATES IN FARM-FORESTRY EXTENSION

Thirty-three States and two Territories carried on cooperative extension work in farm forestry. This is an addition of one State, Montana, which began active cooperation on September 1, 1932. No State discontinued its project. A total of 8,223 farms were assisted in woodland improvement, 6,128 farm tracts were planted with seedling trees, 5,283 windbreaks were established (an increase of 607 over the previous year), 3,371 cleanings were made for controlling white pine blister rust, and 8,195 farms were assisted in various other projects, including marketing of timber products, estimating standing timber, maple-sirup production, and fire prevention.

Federal cooperation in farm forestry, authorized under the Clarke-McNary law (sec. 5), is conducted as a part of the extension program of the several State agricultural colleges and is administered by the Extension Service of the Department of Agriculture, with the cooperation of the Forest Service.

Outstanding progress with substantial increase was made in 4-H club activities. The enrollment of boys and girls conducting forestry projects totaled 15,732, an increase of 48 percent, and 11,416 projects were completed. This junior activity on farms is now being conducted in 39 States and 1 Territory, of which 8 States and the Territory were added during the year. The club work assumes largest importance in Michigan, New Hampshire, New Jersey, New York, North Carolina, Ohio, Tennessee, and Wisconsin.

NATIONAL-FOREST ADMINISTRATION

The expenditures for national-forest administration, protection, improvement, and extension, amounting to \$26,415,714.41, are shown in detail on page 45.

The appropriations and allotments of Federal funds for the national-forest enterprise in the fiscal years 1932, 1933, and 1934 are shown in table 3.

TABLE 3.—*Appropriations of Federal funds and allotments from the National Recovery Administration for the national-forest enterprise, 1932-34*

Item	1932	1933	1934	
			Appropriation	Allowable expenditure
Appropriations:				
General expenses of administration, protection, and improvement.....	\$7, 809, 880	\$7, 483, 824	\$6, 896, 699	\$6, 041, 321
Specifically for:				
Fire control.....	4, 410, 000	1, 125, 000	124, 900	112, 450
Improvements, tree planting, land and resource surveys, and land adjustments.....	2, 866, 440	1, 371, 470	1, 381, 814	367, 652
Land acquisition.....	2, 000, 000	200, 000	85, 854	-----
Roads and trails (construction and maintenance) needed primarily for forest protection and development.....	3, 496, 243. 59	8, 227, 302. 60	260, 343. 30	250, 000
Highway construction and maintenance primarily to meet public needs, as a recognition of Federal responsibility created by ownership of untaxed lands.....	9, 500, 000	10, 905, 000	4, 457, 400	4, 457, 400
Allotments from National Recovery Administration:				
For land acquisition.....	-----	-----	1 20, 000, 000	1 20, 000, 000
For improvements, tree planting, land and resource surveys, land adjustments, tree-disease and insect control, etc.....	-----	-----	1 15, 982, 745	1 15, 982, 745
For roads and trails (construction and maintenance) needed primarily for forest protection and development.....	-----	-----	1 10, 000, 000	1 10, 000, 000
For highway construction and maintenance primarily to meet public needs, as a recognition of Federal responsibility created by ownership of untaxed lands.....	-----	-----	1 15, 000, 000	1 15, 000, 000

¹ Available until June 15, 1935.

The second item in the 1933 column of table 3 is greater by \$1,000,000 than the corresponding sums reported for 1933 in last year's report. This increase took place through a deficiency appropriation of \$1,000,000 to replenish funds drawn upon for fire-fighting expenditures in excess of the nominal amount appropriated in advance for this purpose. As has been explained in earlier reports, this is an established procedure, since the amount that will be required cannot be foreseen and varies greatly from year to year.

The differences in the other appropriation items were brought about by the program for the reduction of the cost of Government. The final column indicates the sums available after applying the restrictions upon full use of the appropriations ordered by the Bureau of the Budget.

THE NATIONAL-FOREST PROPERTIES

The gross area of the national forests on June 30, 1933, was 186,837,499 acres of which 24,828,354 acres was in ownership other than that of the United States making the net area 162,009,145 acres. During the year the gross area increased 622,243 acres, and the net area 648,454 acres. Area computations based on better surveys and land data reduced the gross area 113,330 acres; eliminations by Presidential proclamations or Executive orders 15,220 acres, and State selections under land-exchange agreements 10,521 acres. On the other hand, Presidential proclamations and Executive orders added 623,945 acres, acts of Congress 123,829 acres and land exchanges 13,540 acres.

Table 4 shows the additions and eliminations.

TABLE 4.—*National-forest additions and eliminations, fiscal year 1933*

National forests	State	Additions	Eliminations
		<i>Acres</i>	<i>Acres</i>
Absaroka.....	Montana.....		¹ 6,36
Arapaho.....	Colorado.....	² 960	
Ashley.....	Utah-Wyoming.....	¹ 43,525	
Blackfeet.....	Montana.....	² 628	
Black Hills.....	Wyoming.....	² 1,785	
Do.....	South Dakota.....	² 640	
Cache.....	Utah.....	¹ 10,114	
Carson.....	New Mexico.....		¹ 1
Gunnison.....	Colorado.....	³ 123,829	
Harney.....	South Dakota.....	¹ 998	⁴ 1,1
Nicolet.....	Wisconsin.....	¹ 466,254	
Shasta.....	California.....	² 6,065	
Sierra.....	do.....		¹ 8,7
Snoqualmie.....	Washington.....		⁴ 9,2
St. Joe.....	Idaho.....		⁴ 1
Tongass.....	Alaska.....	¹ 5	
Wasatch.....	Utah.....	¹ 103,049	
Wenatchee.....	Washington.....	² 3,462	
Total.....		761,314	25,7

¹ Made by Presidential proclamation or Executive order.

² Private lands acquired through exchange.

³ Made under acts of Congress.

⁴ Made through State selections of exchange lands.

The largest addition in area was made by a Presidential proclamation which created the Nicolet National Forest, in Wisconsin, embracing lands purchased to be purchased under the Clarke-McNary law. By proclamation the President also added to the Ashley, Cache, Harney, and Wasatch Forests adjoining lands chiefly valuable for timber production or stream-flow control. By an act approved March 4, 1933, Congress enlarged the area of the Gunnison Forest, Colorado. The remaining additions comprised lands acquired by exchange and special laws permitting the acceptance of lands outside national-forest boundaries. The elimination from the Absaroka Forest was transferred to the Yellowstone National Park, and that from the Sierra to the Yosemite National Park. A minor elimination from the Tongass Forest was to permit of entry under the Trade and Manufacturing Act. Aside from a small adjustment on the Carson Forest the remaining eliminations were made to permit of State selections in lieu of lands relinquished within national forests.

To promote economy of administration, the Rainier National Forest, Wash., was partitioned between the Columbia, Snoqualmie, and Wenatchee Forests in the same State, and the Cascade and Santiam National Forests, Oreg., were combined and redesignated as the Willamette National Forest. The Kaibab National Forest, Ariz., was transferred from region 4 to region 3, which administers all other national forests in Arizona, to facilitate the conduct of cooperative work with State agencies.

The need for a substantial enlargement of the national forests was strongly brought out during the year, both by the study of the forest problem pursuant to Senate Resolution 175, Seventy-second Congress, which afforded the basis for the Copeland report, and in other ways. Economic trends are increasingly demanding a systematic planning of all land use. Many movements originating in widely separated geographic centers are coalescing into a national movement, which has found expression in the national land-use planning committee and the national advisory and legislative committee, created by the National Conference on Land Utilization at Chicago in November 1931. The conclusions reached by these committees emphasize the need for extending the national forests. In this connection, it is appropriate to call attention again to the fact that a considerable acreage of public-domain forest lands still remains unappropriated and unreserved.

In planning the work of the Civilian Conservation Corps created by the act of March 31, 1933, many opportunities for effective and constructive work upon public lands of this character came to light. Had these lands been within national forests, prepared plans and resident administrative organizations would have permitted more immediate and effective work and guaranteed its permanent public values and benefits. The public interest calls for the permanent retention of these lands in public ownership. If allowed to pass to other ownerships, they will probably have to be reacquired by the Nation to protect its welfare and security. To reserve them at once would be the wisest course.

LAND ACQUISITION THROUGH EXCHANGE

It is now evident that in private ownership the highly productive and largely out-over forest lands which fringe so many of the national forests as a rule are not and probably never will be protected, managed, and developed to the degree necessary to make them most serviceable permanently to the general welfare. It is equally evident that few of the States concerned are or will be prepared to so protect and manage them. Their damage and deterioration tends to offset the benefits realized through administration of the neighboring lands within the national forests. Extension of the forests to embrace these outside lands is logical.

Several bills to enlarge the present authority to acquire outside lands through exchange were before the last session of the Seventy-second Congress or are now before the Seventy-third Congress, but none of these has been enacted. There are now on the statute books, however, 56 laws authorizing acceptances of lands for national-forest purposes and grants in lieu thereof of national forest or other land, with or without stumpage, or of stumpage alone. These laws indicate consistent recognition by Congress of the desirability of thus consolidating both public and private forest properties.

The volume of exchange business was approximately the same as during the preceding year. Many land-exchange offers were received, but the great majority of the landowners desired national-forest stumpage which would be immediately available and thus would allow prompt cash liquidation of their holdings. Too extensive use of stumpage for exchange purposes would seriously curtail cash timber-sale receipts and the shares payable to the counties.

Privately owned lands within the national forests aggregate almost 25,000,000 acres. They continue to create many acute problems. About 40 to 50 percent of these lands probably is adapted to permanent and constructive private use and management. The rest generally was acquired primarily for its merchantable timber values, and after the timber is removed little further attention is given to the land. The resulting hazards of fire, disease, and insect damage add greatly to the cost and difficulty of protecting the public properties, while the different and frequently conflicting policies applied by the private owners in cutting their merchantable stands militate against the most economic utilization of the intermingled or related public timber. Were 12 or 14 million acres of the interspersed private lands and perhaps 6 or 8 million acres outside but contiguous to the national forests added to them their value would be enhanced and the costs of their protection and management reduced. Consequently there are multiplying proposals that the policy of purchasing lands be extended to the national forests in the Western States. Before that is done, however, consideration properly

might be given to employing for the consolidation of the national forests unreserved public lands which the Government does not plan permanently to retain, by giving equal values of these lands for private lands within the forests.

During the year another exchange with the State of Michigan was approved and submitted to the Secretary of the Interior for action. Through it the State will convey to the United States approximately 15,000 acres of lands within national-forest boundaries, selecting an approximately equal area of unreserved public lands situated within or near State forests. An extensive exchange with the State of New Mexico also was inaugurated during the year, a constitutional amendment authorizing it having been adopted. In Minnesota a constitutional amendment authorizing land exchange with the United States failed to secure the necessary two-thirds vote, although it did receive a majority vote. Consequently it is still impracticable to consolidate the respective State and Federal holdings in Minnesota. Pending exchanges with the States of Colorado, Montana, and South Dakota continued to receive consideration, but have not been consummated.

During the calendar year 1932 reconveyances to the United States of 190,259 acres of private lands in exchange for 41,953 acres of national-forest land and 113,438,000 board feet of national-forest stumpage, valued at \$397,964, added a net 148,306 acres to the forests. The Secretary of Agriculture approved and referred to the Secretary of the Interior for further action 105 new offers of 145,582 acres of privately owned land in exchange for 28,629 acres of national-forest land and \$170,009 worth of stumpage. In all, to December 31, 1932, 923 land-exchange cases had been consummated. Through them the United States has acquired 1,395,359 acres of land, valued at \$5,520,046, in exchange for 432,368 acres of national-forest land, valued at \$1,998,507, and 976,522,000 board feet of national-forest stumpage, valued at \$2,775,357. Besides the net gain of 962,991 acres in national-forest area the volume of stumpage on the acquired lands is much greater than that surrendered.

LAND ACQUISITION THROUGH PURCHASE

The approval with which land acquisition through purchase is now regarded is strikingly illustrated by recent developments in a number of the Eastern States. As has already been shown on page 7, during the year Texas enacted a law authorizing Federal purchases of forest lands; Alabama enlarged its act of consent to include all lands on the drainage of the Tennessee River; Tennessee made its act applicable to the entire State; Missouri, which previously had limited Federal land purchases to a maximum of 2,000 acres in any single county, increased that limit to 25,000 acres; and Wisconsin, where the limit on Federal purchases was first fixed at 250,000 acres, later at 500,000 acres, and still later at 1,000,000 acres, increased it to 2,000,000 acres. The establishment of two national-forest purchase units in the State of Illinois is earnestly advocated by its governor, by its State conservation agencies, and by many local groups; the establishment of several additional units in Mississippi is being aggressively proposed; there is a strong movement in favor of the creation of additional national forests in the eastern part of North Carolina; and keen interest recently has been manifested in the establishment of a new national forest in Maine.

The availability of national forests as fields for the constructive employment of the Civilian Conservation Corps doubtless did much to stimulate interest in the enlargement of the national-forest system. But recent trends in land economy and better analyses of factual data have inspired increased recognition of the tremendous and urgent requirements of the forest situation, the improbability of adequate private action, the inability of the States to carry the whole load, and the fact that the problem is national in its scope and consequences. The most liberal estimates of probable or practicable State and private action for the protection, maintenance, or restoration of forest resources leave a enormous acreage upon which the depletion or destruction of soil and forest resources, with all its attendant evils, will be averted only by Federal action, it is to be averted.

The forest-land purchase provisions of the acts of March 1, 1911, and June 1, 1924, popularly known as the Weeks law and the Clarke-McNary law, are applicable to all parts of the United States but have been applied only to those parts east of the Great Plains. The States west of the Great Plains contain only 2 percent of the total commercial forest area, but 95 percent of the national forest area. The eastern half of the United States, with 74 percent of the total acreage of commercial forest, includes only 5 percent of the area of national forest. The need for an enlargement of the national forests is most urgent and acute in the eastern half of the country, and consequently all appropriations for purchase of forest lands have been expended therein.

The hitherto approved and governing objective of the purchase program has been ultimate Federal ownership of approximately 16,000,000 acres of forest lands east of the ninety-fifth meridian. Factual surveys and analyses now indicate that east of that line something more than 100,000,000 acres of forest land eventually should be protected and administered by the Federal Government. The eastern half of the country not only contains three fourths of the commercial forest area but also almost 90 percent of the total population and the majority of the watersheds most important for navigation, water supply, and flood control. An early enlargement of the purchase program through the establishment of additional purchase areas and extensions of existing units is dictated by all available information.

The economic situation resulted in a strong tendency to liquidate ownership of forest lands, and many offers of sale were received at prices much below previous levels. Since the appropriation for the acquisition of land during the fiscal year was barely enough to complete the cases previously approved by the National Forest Reservation Commission, action on new offers appeared wholly impracticable. By Executive order of May 20, 1933, however, the President allotted for the purchase of lands \$20,000,000 of the funds made available by the act of March 31, 1933, thereby permitting early action upon the large acreage which had been offered, examined and appraised, and covered by options at prices acceptable to the United States.

The stimulus of this action has been tremendous. It has made possible an acceleration and broadening of the acquisition program that has put a wholly new aspect on the whole situation. Before the action was taken, completion of the already established purchase units required the further purchase of more than 7,600,000 acres, and progress had been brought to a standstill for lack of funds. The incomplete condition of the purchase units was a serious obstacle to the most effective use of the Civilian Conservation Corps on the eastern national forests. But the whole outlook was changed literally overnight when the new fund was unexpectedly made available by the President.

During the next hundred days there was approved for purchase by the National Forest Reservation Commission the equivalent of about one fifth the entire acreage acquired during the preceding 22 years, and almost twice as much as during any preceding fiscal year. The total is 941,585 acres, to cost \$1,763,964. Another notable development has been the approval by the Secretary of Agriculture and the National Forest Reservation Commission of an extensive series of new purchase units and additions to existing units, whereby the area to be purchased is increased by approximately 6,000,000 acres. Of the approved new units 4 are in Mississippi, 4 in Missouri, 2 in Illinois, 1 in West Virginia, 1 in Michigan, 1 in Minnesota, and 1 in Puerto Rico.

During the fiscal year ended June 30, 1933, title was taken under the Weeks law, as amended by the Clarke-McNary law, to 163,042 acres, at a cost of \$678,095.7. Purchases totaling 672,425 acres and creating a total obligation of \$1,229,200.04 were approved by the National Forest Reservation Commission. The average price was \$1.85 per acre for the lands approved for purchase and \$4.16 for the lands actually acquired, as compared with a previous average of \$4.55 for all lands acquired. At the close of the year the average cost of all lands actually acquired, not including overhead, was \$4.58, the total \$20,578,410.51, and the area 4,532,698 acres, distributed by States as shown in table 5.

TABLE 5.—Acreage of timberland purchases in the fiscal year 1933 and total purchases to July 1, 1933

State	Purchased in 1933	Average price per acre 1933	Total purchased up to July 1933	State	Purchased in 1933	Average price per acre 1933	Total purchased up to July 1933
	<i>Acres</i>		<i>Acres</i>		<i>Acres</i>		<i>Acres</i>
Alabama.....	4,168	\$5.43	116,333	Oklahoma.....	4,321	\$1.64	58,900
Arkansas.....	15,045	3.12	324,655	Pennsylvania.....	1,879	6.51	371,155
Florida.....	5,102	3.44	234,364	South Carolina.....	129	6.23	47,602
Georgia.....	7,256	3.35	337,519	Tennessee.....	1,264	4.55	388,773
Louisiana.....	2,639	3.55	78,237	Vermont.....	29,539	10.74	31,381
Maine.....			33,482	Virginia.....	4,436	3.18	607,188
Michigan.....	5,932	1.82	309,183	West Virginia.....	2,831	3.70	330,115
Minnesota.....	2,675	1.61	130,580	Wisconsin.....	52,110	1.56	218,086
Mississippi.....	1,910	4.00	1,910				
New Hampshire.....	5,954	4.00	500,955	Total.....	163,042	4.16	4,532,698
North Carolina.....	15,852	3.94	412,280				

COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

Under authority of earlier acts of Congress two areas were transferred from national forests to national parks by Presidential proclamation. The transfer of 6,360 acres from the Absaroka National Forest to the Yellowstone National Park was designed to include within the park certain winter range vital to the park antelope and elk herds. The transfer of 8,785 acres from the Sierra National Forest to the Yosemite National Park was to place within park boundaries all parts of the Wawona road. During the year agreement was reached to exclude from the Dixie National Forest, Utah, approximately 10 square miles embracing Cedar Breaks so that it might be established as a national monument under the administration of the National Park Service, but the formal Executive order to that end was not issued during the year.

The national forests contain many areas of exceptional scenic or recreational quality which annually are used by large numbers of persons. Frequently these same areas also contain important natural resources essential to the economic life and progress of dependent communities, or by their geographic situation control access to and utilization of large economic resources. In many instances carefully regulated industrial use of natural resources would be wholly compatible with full public enjoyment of esthetic, inspirational, and recreational qualities. Often the division of a particular territory between two separate administrative organizations imposes additional and burdensome requirements upon local citizens and markedly increases administrative costs. Accordingly, all determinations of proper national-park and national-forest boundaries should be governed by advanced and applicable principles of systematic land-use planning and by comparative evaluations of all social and economic factors and requirements.

NORTHERN PACIFIC LAND-GRANT ADJUDICATION

The suit to adjudicate the equities of the Northern Pacific Railway Co. under the Land Grant Act of July 2, 1864, the resolution of May 31, 1870, and other supplementary laws, as authorized by the act of June 25, 1929, received the attention of the Department of Justice throughout the year, the Forest Service furnishing such cooperation as was necessary in relation to land classifications and valuations and other relevant matters. Briefs, evidence, and arguments were presented to and considered by the master appointed by the Federal court of the eastern district of the State of Washington, before which the case is being tried.

LAND ACQUISITION THROUGH DONATIONS

Acceptance of donations of lands for national-forest purposes is authorized by section 7 of the act approved June 7, 1924 (43 Stat. 653), and by the act approved March 3, 1925 (43 Stat. 1133), and a few donations have been made and accepted; but prior to the fiscal year 1933 they were not of sufficient volume or importance to warrant specific mention in this report. Recent trends, however, give promise that the consolidation and extension of the national forests through voluntary donations of lands by the owners will hereafter be a matter of frequent occurrence and increasing importance. Donations during the year amounted to 26,117 acres in California and 113,120 acres in Idaho. Because of the work incident to the review and adjustment of titles only 80 acres, in California, had finally been accepted at the close of the year, but there is every indication that all of the donated land will be acceptable.

SPECIAL USES

Special-use permits in effect at the close of the calendar year 1932 totaled 37,306, as against 36,457 at the close of the preceding year. Of the permits in effect, 17,615 were without charge and 19,691 were subject to annual-rental charges. The receipts for the fiscal year 1933, \$278,182.35, were less by \$14,977 than for 1932, but the difference is in part covered by notes from permittees who unable to pay their fees but wishing to avoid removal of their improvements offered notes for which the improvements would be ample security. The bill to authorize a maximum area of 80 acres for term permits has been reintroduced in the Seventy-third Congress, and its enactment is most desirable. With such authority, higher standards of construction and development could be obtained and public services, public revenues, and taxable values would all be correspondingly enhanced. The national forests contain many areas valuable for purpose of commerce and industry which appropriately may be so employed without

conflict with the basic purposes and uses of the national forests, and their full development and use would contribute markedly toward the welfare of the dependent communities.

CLAIMS AND SETTLEMENT

During the calendar year 1932 reports on applications for homestead patents totaled 69, of which 61 were favorable and 8 unfavorable; while reports on applications for mineral patents numbered 145, of which 105 were favorable and 40 unfavorable. Notwithstanding a pronounced trend from urban to rural life, bona fide and non-speculative applications for the listing of forest lands did not greatly increase. While placer mining within the national forests was greatly stimulated by increased industrial unemployment, the resulting placer locations are not ordinarily covered by mineral application. Many applications for mineral patent are due to the fact that if land of large value for purposes of commerce, industry, or recreation contains even slight evidences of mineralization, the general mining laws afford an excellent opportunity to establish private ownership, regardless of the public values involved. This situation should be corrected by appropriate legislative action.

PROTECTION FROM FIRE

All fire seasons are different, and in this respect only was the 1932 season normal. It had most of the characteristics of a "bad" year, yet never became one. Although it was an extraordinarily long, dry, hot, and windy season it did not result in an exceptional number of fires. July and August are normally the peak months in the West, but in 1932 the seasonal peaks were in June and September. The number of fires was 92 percent of the average for the last 5 years, the area burned 83 percent, the fire-fighting expenditures 47 percent, the damage 29 percent. It was a season of contradictions, with near-emergencies, near record-breaking achievements, and only one really bad fire.

It opened early, both East and West—before the protective force had been increased to full seasonal strength. In the Northwest the June precipitation was below normal and dangerous conditions developed. July and August continued dry, with the precipitation below normal and wind velocities above. This condition held into September, and still longer in southern California. From the standpoint of duration of fire weather, shortage of precipitation, and wind, the record was one of the worst known. But what precipitation fell was well distributed; there were no bad concentrations of lightning fires; and there were no long periods of extremely low humidity such as those which characterized the 1931 season. The organization functioned with machinelike precision and had the situation under complete control down to September 7. Until then, less than half an acre had been burned over for each thousand acres protected. On that date a hunter on the Santa Barbara Forest in California started a fire which spread rapidly, burned 12 days, and required for its control a crew of 2,500 men. Except for this fire the record closely parallels that of 1930, a very much shorter and easier season.

Protecting the 160 million acres of national-forest land from fire is not only a large but also a very complex job. Years ago it was realized that there is no single road to success. The problem has to be worked out through the gradual development and coordination and perfection of all factors—equipment, transportation, communication, and personnel. In the nature of the case progress is slow, laborious, and difficult to gauge accurately. Chance plays a large part; and the possibilities for a small slip-up somewhere are well-nigh limitless. A man may be well-trained in a hundred things, yet for lack of preparedness on one score let a fire get away; one out of a thousand telephones, all supposedly in perfect order, may be off for an hour just when it is most needed; favorable weather may cause overconfidence that will suddenly prove unfounded. Such things as these make caution necessary in comparing the records of successive years. Table 6 shows the 1932 fire record, in comparison with that of 1931 and with the 5-year average for 1928-32.

TABLE 6.—*Comparison of fires on national forests, calendar years 1932, 1931, and 5-year average, 1928-32*

Class of fire and cause	Number of fires			Percentage of total		
	1932	1931	Average, 1928-32	1932	1931	Average, 1928-32
Class:						
Burns of 0.25 acre or less.....	4, 146	4, 676	4, 291	58. 92	55. 23	56. 0
Burns of between 0.25 and 10 acres.....	1, 811	2, 258	2, 054	25. 73	26. 67	26. 8
Burns of 10 acres and over.....	1, 080	1, 532	1, 308	15. 35	18. 10	17. 0
Total.....	7, 037	8, 466	7, 653	100. 00	100. 00	100. 0
Cause:						
Railroads.....	85	166	199	1. 21	1. 96	2. 0
Lightning.....	2, 690	2, 917	3, 267	38. 23	34. 45	42. 6
Incendiarism.....	1, 268	1, 444	1, 095	18. 02	17. 06	14. 3
Debris burning.....	281	449	309	3. 99	5. 30	4. 0
Lumbering.....	49	92	103	. 70	1. 09	1. 3
Campfires.....	747	992	775	10. 61	11. 72	10. 1
Smokers.....	1, 564	1, 872	1, 526	22. 22	22. 11	19. 9
Miscellaneous.....	353	534	379	5. 02	6. 31	4. 9
Total.....	7, 037	8, 466	7, 653	100. 00	100. 00	100. 0

Calendar year	Total area of national-forest land burned over	Total damage of national-forest land burned over	Total cost of fighting fires, exclusive of time of forest officers
	<i>Acres</i>	<i>Dollars</i>	<i>Dollars</i>
1932.....	372, 973	568, 349	997, 4
1931.....	532, 761	3, 652, 248	4, 049, 4
5-year average, 1928-32.....	448, 332	1, 948, 273	2, 127, 0

Most of the difference between 1931 and 1932 must be attributed to the weather. The improvement shown over the 5-year average, however, can hardly be so explained. It is best brought out by combining the factors of cost and damage. The objective in protection is to keep both low. By disregarding one or the other may be reduced. Last year the "cost-plus-damage" per fire averaged \$223, as against \$533 for the 5-year period.

Particular stress was laid on mastering fires during the first burning period. This requires quick and skillful action by a man power sufficient to insure control. Only 1 fire out of every 29 burned uncontrolled beyond the first period. In 1931 there was 1 out of every 24. In part this difference was due to the season but in part to more effective action.

Both incendiary fires and smokers' fires outnumbered the 5-year average, but both were below the 1931 number. Incendiary fires fluctuate with economic conditions. In 1927 there were only 397; in 1931, 1,444. In 1932, control methods were effective wherever incendiarism was bad the year before, although unemployment conditions were even worse. Incendiarism broke out sporadically in a number of new localities, but in each case was quickly controlled. The total number of such fires was 12 percent less than in 1931.

Smoker fires also are affected by economic conditions. The number of men on work revived prospecting and placer mining on a large scale. Many draws and stream courses were alive with prospectors and placer miners. Berry pickers also were unusually numerous. The men of both classes were careful and cooperative, but where there are great numbers of people there will be some fire.

The struggle of the Forest Service with fire has been going on for many years. A good job was being done 20 years ago. Progress becomes each year more difficult. Quick action has always been emphasized. Every minute of delay counts. Plans are made for quick action; men are trained for quick action; all equipment and improvements are designed with the same end in view. In 1919 and 1922, 39 percent of all fires were reached within 1 hour after discovery; in 1931 and 1932, 51 percent. This 12-percent gain brought 1,860 additional fires within the 1-hour period.

Another necessity is quick suppression. Tools have been designed to speed action, and emphasis has been placed on power equipment, particularly the horse and plow. In 1921 and 1922 45 percent of all fires were controlled within 1 hour after they were reached; in 1931 and 1932 55 percent. This was a gain of 1,550 acres. Since the later seasons were the more severe, no part of this gain can be attributed to natural causes.

One factor which still tends to keep records poor is the blind areas not directly covered by lookouts. To remedy this a study is being made in the fire regions of lookout points. Maps are being made from all points to show the area visible. From the combined maps the best series of points will be chosen to get the best coverage of the forest. The results indicate that some improvement can be made without increasing the actual number of lookouts.

This study of lookouts is not an isolated study but an exemplification of a broad and long-continued search everywhere for new fire facts. This search will be continued. It has resulted in a new type of portable radio practicable for field use, described in previous reports; it has developed a new type of protection road and the equipment for its construction; it has improved equipment and methods in a thousand different ways; and above all it has developed methods of organization which enable a ranger to expand his force a hundredfold, equip and supply the expanded unit, and begin effective work with no appreciable loss of time. But facts sought for are not confined to these mechanical features of the problem. We are concerned also with broader economic and social phases of protection.

In this connection probably the outstanding achievement in fire history for 1932 was the field study made of back-country or low-value areas. In 1930 the regional foresters agreed that the degree of protection should vary with the value of the timber, and made a rough classification based largely on types. Putting the idea into effect, however, developed two outstanding difficulties. The first was the difficulty of controlling the situation in this manner, less intensive effort sometimes resulting, in the end, in greater expenditures. The second is the difficulty in appraising values. The timber value, the only one subject to direct monetary appraisal, is not always the most important. Erosion control, water storage, recreation, and game values all have their place. Wilderness values have only recently been recognized, but in 50 years may be the greatest in some back-country localities.

During the 1932 field season two parties of forest officers made trips into one of the largest inaccessible back-country areas to discuss on the ground the values that were being protected and the possibility of using more extensive methods in their protection. The discussions resulted in a better understanding of the problem and in plans for further study. Experiments are being made in regions 5 and 6 to develop extensive yet safe methods in fire control. The principle is accepted that values protected should be greater than the cost of protection, but the control of costs when dealing with fire in the woods is difficult.

THE 1933 FIRE SEASON

The 1933 fire season up to September 1, the date of this report, has been considered an easy one, although exceptionally bad fires in both the Lake States and the Northwest, outside the national forests, indicate that there have been periods in which burning conditions were much above normal. However, such periods have been short as compared with those in the 1931 season, and while there has been considerable dry, hot weather, rains have been well distributed and humidity conditions usually favorable.

As to number of fires and area burned, the season so far has been almost a duplicate of last year. The number of fires up to August 20, 1932, was 4,353; up to the same date in 1933, 4,305. The area burned in 1932 was 75,649 acres, as against 64,823 acres this year. In cost-plus-damage, however, this year has so far a decided advantage. This may in part be due to the aid of the Civilian Conservation Corps.

The presence of this Corps has been in many ways a help. Their presence has emphasized the importance of the forests and the need for care with fire, and has been a deterrent to incendiarism; and the men themselves have done good work in fire fighting. On the other hand, the conservation camps have taken much of the time of administrative officers that normally is given to training and supervising the protection forces. The ultimate result, however, will be a multitude of young men interested from first-hand experiences in forest protection.

Unless there is some unlooked-for change in conditions the 1933 fire record will be one of the best in national-forest history.

PROTECTION FROM TREE DISEASES AND INSECTS

The white pine blister rust, the most menacing tree disease on the national forests, has continued its spread in the western white pine of Idaho, western Montana, and eastern Washington, despite control efforts which proved inadequate. If the disease is not checked the entire white-pine lumber industry of the inland empire will be practically wiped out. There are now 75 centers of infestation, of which 5 are new centers found in 1932 on the Clearwater National Forest and 5 are new centers found on the Coeur d'Alene. The disease attacks and kills the young growth and reproduction along with the mature timber, thus rapidly eliminating white pine from the forest. The disease has not yet reached the California sugar pine, the most valuable timber species of the State, but has been found on sugar pine north of the California-Oregon line. Control accomplished by finding and destroying all Ribes (currant and gooseberry) in the areas to be protected. Ribes and white pine are alternate hosts of the blister rust, and without both it cannot spread or survive. The Forest Service uses the methods of control recommended by the Bureau of Plant Industry, and works in close cooperation with that Bureau, which handles all the control work on lands outside of the national forests.

The best estimate is that there are at least 1,000,000 acres of western white pine land owned by the Government within the national forests of the inland empire, of such excellent productive capacity as to justify large-scale control operations. The Forest Service undertakes control work only where the value at stake justifies the outlay financially. If some other tree can be grown in place of the pine, that promises to afford a return equal to or greater than that obtainable from pine with the cost of control taken into account, control measures are not undertaken. The organization of the Civilian Conservation Corps has made possible a much more aggressive attack on the infestation since July 1.

From the standpoint of insect control, the year was signalized by two outstanding occurrences. Throughout the lodgepole, ponderosa, and western white pine regions other than the Southwest, there was the worst general insect infestation that has occurred in more than a decade. On the other hand, unusual cold weather in December 1932 and February 1933 probably resulted in the greatest mortality of the ponderosa pine bark beetles that has occurred in the last decade.

The major insect infestations are usually those of bark beetles. Beetle attacks gained momentum during the dry years of 1930 and 1931, and during the summer of 1932 the insects multiplied rapidly. Large-scale operations to control heavy lodgepole pine infestations were carried on in northern Utah and southeastern Idaho, on the Wasatch, Ashley, and Cache National Forests. The treatment consists mostly of spraying the infested tree stems with oil, which is then set on fire and more oil sprayed on until the bark becomes hot enough to kill the larvae. Only thin-barked species of trees can be successfully treated by this method. The entire Cache Forest, on which the largest job was undertaken, was cleared of the epidemic. On the Wasatch and Ashley the control work was stopped by heavy snow in the fall of 1932, but was completed in the spring of 1933.

Control work was continued in the valuable western white-pine timber stands on the Coeur d'Alene National Forest, in north-central Idaho, where the work done in the spring of 1932 had curbed but not completely broken the infestation. A beetle attack which had been gathering headway during 1930 and 1931 in ponderosa pine stands of eastern Oregon broke out furiously during the summer of 1932. Control work on a large scale was inaugurated on the Ochoco Forest in cooperation with the owners of adjoining private timber. The method employed was to fell the infested trees and burn the bark.

Abnormally low temperatures in December 1932, and again in February 1933, killed so large a percentage of the beetles on the Ochoco, Deschutes, and Fremont Forest that further measures of control were deemed unnecessary by the Bureau of Entomology, and the Forest Service was so advised. This saved unnecessary expenditures and exemplifies the value of the excellent cooperation given by the Bureau of Entomology, whose immediate investigation and interpretation of the results of the cold weather enabled the Forest Service to halt the work. Variations in degrees of mortality in the infestations of the same beetle took place in all the States of the Pacific Coast States, as far south as central California.

In the spring of 1933 insect-control projects were undertaken on insect epidemics in the Sierra, Modoc, and Shasta National Forests of California. Control of the Sierra projects and the Shasta project were carried on in cooperation with private owners of adjoining infested areas, and a project on the Wawona Forest area of the Sierra Forest, adjoining the Yosemite National Park, was handled

in cooperation with the Park Service. All insect-control work on the national forests is done by the methods recommended by the Bureau of Entomology.

TIMBER

The cut of national-forest timber under sales and exchanges was 473,910,000 board feet, as against 611,751,000 board feet in the fiscal year 1932 and 1,653,355,000 board feet in the fiscal year 1930. In view of the conditions in the lumber industry the production of lumber from national-forest timber was not encouraged. Extensions of time within which to complete contracts or to cut definite quantities were given on a liberal basis. Sales were closed only when, as in the case of two contracts for pulpwood in Alaska, it was evident that operations were unlikely to begin for an indefinite period. The policy was continued of not offering sales which would probably lead to the establishment of new large mills.

Toward the close of the year, with stocks of lumber in the yards and at the mills throughout the country greatly reduced, a revival of demand and production was reflected in a small but distinct increase in the national-forest timber business. The receipts from sales and the quantity of timber cut during the last quarter of the year were substantially greater than in the corresponding 1932 period. The upturn was widely distributed, the increase in receipts coming from all regions except California and Alaska.

In contrast with the continued low level of activity in large-scale timber operations, which in normal years account for more than 90 percent of the cut, the number of small sales (transactions involving \$500 or less) has remained nearly constant through the depression. They are a highly important form of local service. In the calendar year 1932 they numbered 14,294, as against 68 larger sales. Free use increased sharply. More than 125,000 persons or organizations— an increase of 54 percent over 1931—cut a volume equivalent to 270,240,000 board feet, an increase of 61 percent. In many cases municipal or other organizations cut wood as a means both of furnishing labor to the unemployed and of obtaining a necessity of life for distribution to the destitute. This free use of timber was controlled and located so that the cutting removed fire dangers or improved conditions for the future growth of the forest.

The Civilian Conservation Corps started work on the national forests during the spring of 1933, and a large amount of stand-improvement work was planned and begun. Stand-improvement work is needed on practically all national forests, but it is most needed on the eastern forests. This work consists mainly of a liberation cutting, which is the removal of brush or of weed trees, usually of comparatively small size, to release trees of a more valuable species; thinning, which is the removal of a number of the trees on a given area in order to increase the rate of growth of the remaining trees and to shorten the period until the stand in the area will be ripe for a cutting; and improvement cutting, which is the removal of inferior species and insect-infested, diseased, or deformed trees, to benefit the composition and growth of the stand left. The work is done only in young stands.

All stand-improvement work for timber production on the national forests will be confined to work which is expected to yield a financial profit on the investment. Many thousands of acres of the national forests will be put in a much better condition for growth. There is and will be a large amount of work of this nature to be done annually, in the same manner as weeding of planted crops on a farm is an essential and worth-while investment. It is hoped that cultural or stand-improvement work may be continued annually on a scale adequate to keep the most valuable national forest timber-producing lands in the most profitable and productive condition. Stand-improvement work will yield large returns both to the local communities and to the Nation.

The national forest timber-sale business for the fiscal year is summarized in tables 7 and 8. Since the corresponding tables have for some years shown the record not by fiscal but by calendar years, this leaves a gap of 6 months between last year's record and that shown below. In the calendar year 1932 the cut under commercial sales was 366,076,000 board feet with a value of \$815,105, as against 774,686,000 board feet with a value of \$2,010,332 in 1931. The cuts under cost sales for the 2 years were respectively 17,639,000 board feet, with a value of \$15,579, and 19,130,000 board feet, with a value of \$17,657. The quantity of timber sold under commercial sales in the calendar year 1932 was 35,218,000 board feet, and under cost sales 17,361,000 board feet, as against 84,851,000 and 20,455,000 board feet in 1931.

TABLE 7.—Quantity and value of national-forest timber cut under sales, fiscal year 1933

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alabama	2,000		2,000	11		
Alaska	17,279,000		17,279,000	26,618		26,618
Arizona	74,723,000	249,000	74,972,000	178,059	244	178,303
Arkansas	2,011,000	629,000	2,640,000	9,022	629	9,651
California	57,941,000	1,383,000	59,324,000	127,102	932	128,034
Colorado	16,279,000	727,000	17,006,000	34,644	709	35,353
Florida	2,759,000		2,759,000	5,064		5,064
Idaho	19,095,000	5,582,000	24,677,000	52,877	4,478	57,355
Louisiana	134,000		134,000	62		62
Michigan	882,000	49,000	931,000	985	49	1,034
Minnesota	3,658,000		3,658,000	4,815		4,815
Montana	6,197,000	3,289,000	9,486,000	13,085	3,289	16,374
Nebraska						
Nevada	449,000	182,000	631,000	469	150	619
New Hampshire	1,848,000		1,848,000	6,609		6,609
New Mexico	7,624,000	864,000	8,488,000	15,392	874	16,266
North Carolina	8,339,000		8,339,000	19,397		19,397
Oklahoma	125,000		125,000	187		187
Oregon	24,827,000	2,675,000	27,502,000	52,583	1,793	54,376
Pennsylvania	597,000		597,000	1,128		1,128
Puerto Rico	12,000		12,000	305		305
South Dakota	12,905,000	226,000	13,131,000	43,812	220	44,032
Tennessee	1,515,000		1,515,000	3,772		3,772
Utah	4,131,000	1,165,000	5,296,000	7,932	1,177	9,109
Virginia	12,403,000		12,403,000	10,942		10,942
Vermont	6,000		6,000	12		12
Washington	84,540,000	200,000	84,740,000	181,412	141	181,553
West Virginia	24,000		24,000	109		109
Wisconsin	152,000		152,000	197		197
Wyoming	11,225,000	596,000	11,821,000	26,554	476	27,030
Total	371,682,000	17,816,000	389,498,000	823,156	15,161	838,317

¹ In addition, minor products not convertible into board feet were cut, the value being \$18,524.

TABLE 8.—Quantity and value of national-forest timber sold, fiscal year 1933

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alabama	2,000		2,000	11		
Alaska	23,372,000		23,372,000	35,356		35,356
Arizona	114,619,000	252,000	114,871,000	231,424	265	231,689
Arkansas	7,328,000	649,000	7,977,000	28,064	649	28,713
California	37,980,000	1,347,000	39,327,000	58,756	974	59,730
Colorado	10,664,000	749,000	11,413,000	21,786	688	22,474
Florida	1,850,000		1,850,000	3,440		3,440
Idaho	21,083,000	4,593,000	25,676,000	64,240	3,804	68,044
Louisiana	133,000		133,000	62		62
Michigan	1,062,000	103,000	1,165,000	1,445	103	1,548
Minnesota	1,373,000		1,373,000	1,851		1,851
Montana	8,378,000	3,578,000	11,956,000	19,743	3,522	23,265
Nebraska						
Nevada	518,000	228,000	746,000	366	186	552
New Hampshire	2,555,000		2,555,000	5,975		5,975
New Mexico	5,425,000	896,000	6,321,000	11,922	925	12,847
North Carolina	13,702,000		13,702,000	23,173		23,173
Oklahoma	125,000		125,000	186		186
Oregon	21,142,000	2,925,000	24,067,000	33,732	1,902	35,634
Pennsylvania	6,459,000		6,459,000	11,363		11,363
Puerto Rico	12,000		12,000	305		305
South Dakota	17,619,000	326,000	17,945,000	41,914	326	42,240
Tennessee	879,000		879,000	2,332		2,332
Utah	3,152,000	1,573,000	4,725,000	5,413	1,600	7,013
Virginia	12,882,000		12,882,000	8,950		8,950
Vermont	39,000		39,000	95		95
Washington	17,994,000	215,000	18,209,000	28,976	160	29,136
West Virginia	16,000		16,000	47		47
Wisconsin	211,000		211,000	231		231
Wyoming	7,795,000	635,000	8,430,000	16,957	588	17,545
Total	338,369,000	18,069,000	356,438,000	658,115	15,692	673,807

¹ In addition, minor products not convertible into board feet were sold, the value being \$31,711.

PLANTING

In the planting work the outstanding event of the year was the enactment of the Emergency Conservation Act. Despite the fact that only a relatively short period of the planting season was available after the first of the Civilian Conservation Corps camps were established in the woods, approximately 3 million trees were planted on national-forest lands by members of the corps before the year closed. All Forest Service nurseries were seeded to capacity, and a new temporary nursery was constructed and seeded at Cass Lake, Minn., which is expected to supply 15 million 1-year-old pine seedlings for planting in the fall of 1933 and approximately 50 million 2-year-old seedlings for the fall of 1934. Civilian Conservation workers are being largely used in maintaining the nurseries and preparing planting areas, and will be used in the fall planting.

For many years the planting program for the national forests has lagged. At the past rate, many hundred thousand acres of potentially highly productive timberland will long continue to be occupied only by worthless brush or weed trees. This constitutes a material economic loss. In the calendar year 1932 the area planted was 24,755 acres. Only once has a greater acreage been attained. But more than 2 million acres greatly need planting. An annual rate of 25,000 acres is totally inadequate. The act of June 9, 1930, commonly known as the Knutson-Vandenberg Act, authorized a planting appropriation of \$300,000 for this year. The actual appropriation was \$154,200. Since the act was passed the area to be planted has been increased through the purchase of additional eastern lands. The President has greatly accelerated the execution of the purchase program by making available \$20,000,000 for this purpose. The lands to be acquired will in a considerable part be cut-over and burned-over areas, on which much planting must be done to make them fully productive. The work can be economically and effectively done only if a planned program can be followed through, with advance authorizations and corresponding later appropriations.

The area planted on national forests during the calendar year 1932 is shown, by States, in table 9. In addition 10 acres in Minnesota were sown.

TABLE 9.—*Planting on national forests, by States, calendar year 1932*

State	Area planted	State	Area planted	State	Area planted
	<i>Acres</i>		<i>Acres</i>		<i>Acres</i>
Arizona.....	11.4	New Hampshire.....	9.9	Utah.....	33.2
Arkansas.....	796.4	Nevada.....	5.0	Virginia.....	41.5
California.....	290.3	New Mexico.....	4.5	Washington.....	2,338.0
Colorado.....	2,548.4	Oklahoma.....	.5	West Virginia.....	319.1
Idaho.....	2,022.0	Oregon.....	139.0	Wisconsin.....	3,173.2
Montana.....	121.0	Pennsylvania.....	45.1	Wyoming.....	442.9
Michigan.....	9,386.5	Puerto Rico.....	.7		
Minnesota.....	96.0	South Dakota.....	1,519.4	Total.....	24,755.2
Nebraska.....	1,304.7	Tennessee.....	106.5		

RANGE

The winter of 1931-32, following widespread drought, in most of the range country was unusually severe. A general shortage of winter feed combined with inability of western producers to finance the purchase of high-priced feeds on a declining livestock market to cause heavy losses of livestock; and the early part of the year 1932 was most discouraging. As spring advanced, however, the situation in Montana, Oregon, Washington, California, Utah, Idaho, and Nevada became more promising. The heavy winter snowfall assured ample water for irrigation, while spring and summer rains brought on a crop of range and ranch forage in marked contrast to that of previous years.

Over much of Wyoming and Colorado, however, the heavy winter snow was followed by subnormal summer conditions; and parts of Arizona and New Mexico suffered a cold spring and spotty summer rainfall. Despite the adverse developments and the generally poor condition of the livestock at the opening of the season, stock left the national-forest ranges as marketable animals, in contrast to much unsalable stock from outside open range. Times of stress bring out pointedly the superiority of well-cared-for ranges over those subject to unregulated use.

GRAZING FEES

In 1932 livestock prices reached the lowest point in more than 20 years. This coupled with the other unusual burdens of the stockmen, led to a demand for a reduction or remission of the grazing fee. After a thorough canvass of the situation, and in view of the previous winter losses, high costs of feed, and general drought conditions, the Secretary of Agriculture reduced the grazing fee by 50 percent for the season of 1932. To make the reduction of the greatest possible help, it was applied to the first installment of the grazing fees, which is due in advance of the opening date. Consequently the grazing receipts for the fiscal year 1932, which would ordinarily have been about \$2,000,000, were reduced to \$820,000.

While the unprecedented situation confronting the livestock grower during the past 2 years has brought about economies in operation, it has also brought increases in mortgage indebtedness and interest charges. In view of the emergency conditions the Forest Service made it known early in 1932 that no deserving stockman would be denied a grazing permit because of failure to pay a part or all of the fee in advance. Notes bearing interest were accepted where the permittee was unable to finance his operation through the regular channels, was fully qualified as a permittee, and had always met his obligations to the Forest Service. On December 31, 1932, unpaid grazing fees for the calendar year 1931 totaled \$59,097.35, and for the calendar year 1932, \$399,307.95, with 8,704 permittees, or 33 percent, delinquent. By the time the 1933 grazing season opened the amount due had been greatly reduced.

The general economic situation has given rise to a demand for a lower basic rate for the grazing fees. It will be recalled that the decision of the Secretary of Agriculture on January 25, 1927, which established the rates for the remainder of the 10-year term permit period ending with the 1934 season, expressly stated that for the next term-permit period consideration would be given the practicability of relating the grazing fees to the market prices of livestock. The users of the national forests argued with much force that no such severe depression as the present one had ever been experienced, and it was unlikely that its equal would ever be experienced again. It was urged that a readjustment would be especially timely, appropriate, and fair in view of the existing price situation, and all that was being requested was the advancement of the study by 2 years.

After full consideration of the question, the Secretary of Agriculture instructed the Forest Service to make the study. It led to the recommendation of a plan which was approved by the Secretary of Agriculture on May 27, 1933. Briefly the new plan provides:

1. That the average national-forest grazing fees of 14.5 cents per head per month for cattle and 4.5 cents per head per month for sheep in effect during 1932 be used as the basic fees, subject to adjustment each year in accord with fluctuations in livestock prices.

2. That the adjusted fees each year shall have the same ratio to the basic fees that the average price received by producers in the 11 Western States during the immediately preceding year had to the corresponding average price during the period 1921-30, inclusive, in the case of cattle, and during the period 1920-32, inclusive, in the case of sheep.

3. That the cattle prices to be used in adjusting the fees shall be the prices received for beef cattle as compiled by the Bureau of Agricultural Economics and the sheep prices shall be the prices received for lambs as likewise compiled by the Bureau of Agricultural Economics.

4. That in adjusting the grazing fees for 1933 in accordance with the provisions of the preceding paragraphs, 4.13 cents be considered the average price per pound for beef cattle for 1932, and 4.18 cents the corresponding price for lambs that the average fee for 1933 as thus determined will be 9.05 cents per head per month for cattle, or 37.6 percent less than the average cattle fee determined by appraisal. For sheep the average fee in 1933 will be 2.05 cents per head per month, or 54 percent less than the average sheep fee determined by appraisal.

5. That the Forester be authorized to refund any amount collected for the year 1933 in excess of the adjusted fee, or to apply any such excess to the payment of any fees due or to be due, and to collect such additional payments as may be required to secure full payment of the fees as adjusted for the year 1933.

6. That no adjustments in fees be made when the application of the above formula would affect the fees by less than one-half cent for cattle and one-quarter cent for sheep per head per month, and that in the establishment of all fees they be rounded off to the nearest cent for cattle and the nearest quarter cent for sheep per head per month.

7. That the Forester be authorized to make such adjustments from time to time as may be necessary to establish equitable fees between allotments, forests, regions, or States.

In the reports submitting the plan, which was also approved by the Secretary, it is made clear that:

1. No usable means of determining directly the value of forage in terms of livestock market prices has been devised.

2. The best and most direct index of the value of forage on national forests is the price which stockmen pay for forage on comparable privately owned lands.

3. Forage values as thus indicated are adequately expressed in range-appraisal data used as the basis of grazing fees now in effect.

4. Rental values of private land tend to reflect price levels received for the commodities produced on the lands, but to a less marked extent and with a tendency to lag behind the changes in livestock prices.

5. By correlating the grazing fees as determined from the forage values on leased private lands with the average prices received for livestock over a representative period of years, a basis is provided for determining a working relationship between current grazing fees and current livestock prices.

The approval of this plan marks an innovation in the past policy. While it maintains the basic schedule of fees adopted in 1927, it recognizes that prices received by the producer year by year are the best indices to the ability to pay for a given commodity. So far as is known, it is the first attempt to employ such a method on a large scale. The success of the plan will depend largely upon its acceptance by the users with the understanding that fees will fluctuate with prices of livestock. This is exemplified by the working of the plan for 1933, when a low livestock price results in a reduction of the fee. As and when the prices of livestock increase, the grazing fee also will increase.

It should also be understood that this plan must be applied broadly. Fees will not be subject to adjustment to meet special conditions affecting individuals or localities only.

RANGE USE

Table 10 shows the grazing use made of the national forests in the calendar year 1932.

TABLE 10.—*Grazing permits issued and numbers of stock allowed under pay permit on the national forests, by States, calendar year 1932*

State	Cattle, horses, and swine				Sheep and goats		
	Permits issued	Stock grazed			Permits issued	Stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Alabama.....	1	20					
Arizona.....	985	187,841	1,421	157	168	290,072	1,786
Arkansas.....	184	3,383	15	135	2	38	
California.....	1,816	143,249	4,018	95	327	382,178	924
Colorado.....	3,067	281,444	2,470		903	992,133	537
Florida.....	23	1,354		22	2	719	
Idaho.....	2,640	120,732	5,214		952	1,289,137	
Montana.....	1,899	124,343	6,629		449	616,577	97
Nebraska.....	32	12,960	461				
Nevada.....	348	50,787	1,819		156	309,552	
New Hampshire.....	16	212	7				
New Mexico.....	1,996	88,669	2,148	104	304	211,156	9,064
North Carolina.....	115	761	1	8	7	104	
Oklahoma.....	46	2,312					
Oregon.....	1,128	83,695	1,521		470	643,083	30
Pennsylvania.....	2	52					
South Dakota.....	621	28,581	1,028		57	34,137	
Tennessee.....	47	345	1		4	63	
Utah.....	3,785	111,117	3,402	7	1,938	749,504	
Virginia.....	103	1,005	6		18	396	
Washington.....	436	13,038	396		120	149,393	
West Virginia.....	33	273	13		46	1,118	
Wyoming.....	752	104,987	4,535		294	639,140	
Total, 1932.....	20,075	1,361,160	35,105	528	6,157	6,308,500	12,438
Total, 1931.....	19,388	1,338,373	37,335	431	6,319	6,593,583	14,645

The table shows that 687 more permittees grazed 20,654 more cattle, horses, and swine in 1932 than in 1931; but the average of 70 head per permittee was 1 less than the 1931 average. On the other hand, there were 162 fewer sheep and goat permittees and 287,290 fewer sheep and goats than in 1931. These

differences are chiefly in response to the general economic situation. In 1932 7,013 cattle, 264 horses, and 83,246 sheep grazed, under interforest permit, on more than one forest in the course of the season.

In addition to the stock under permits, 62,055 cattle and horses and 8,359 sheep and goats were grazed in the six Western national-forest regions under the regulation authorizing free grazing of not to exceed 10 head of stock used for domestic purposes, and stock used by prospectors, campers, and travelers, or used in connection with permitted operations on a national forest.

Unfavorable seasonal and economic conditions combined to make both the authorized use and the actual use less in 1932 than in 1931. The authorized use was less by 13,537 cattle-months and 1,156,070 sheep-months, and the actual use by 75,821 cattle-months and 1,681,749 sheep-months.

The amount of nonuse, or retention of preference without grazing the stock, generally reflects economic conditions. Permittees were granted nonuse during 1932 for 79,900 cattle and horses and 410,902 sheep and goats. This is about the same number of cattle and horses and nearly twice the number of sheep and goats covered by nonuse during 1931.

STABILITY OF RANGE USE

The demand for summer range continues to be far greater than the national forests can supply. Many complaints were received from disappointed applicants for the grazing privilege. That the demand will increase as ranges improve on the national forests and decline on outside areas is, of course, to be expected. It is also to be expected that fully qualified applicants, or those who own and live on ranch property of a similar character to that owned by present permittees, will be dissatisfied under a combination of policy and conditions which excludes them while according others, who came before them, fairly permanent occupancy privileges.

While the Forest Service fully appreciates the situation of these applicants and seeks to make places for them wherever this can be done under the established policies, it holds that a distribution of the privilege which will accord as nearly as possible with the economic requirements of the business of livestock production will in the long run best serve community welfare. The effects of protracted and unusual drought have been manifested in reduced production of forage and overgrazing on certain areas, making it impossible to use much of the leeway ordinarily gained in connection with transfers of stock ownership and in other ways as a means of admitting new owners or allowing increases to small owners. Unless the operations of present users are to be greatly curtailed, with an attendant decline in the productivity of ranches dependent upon forest use, extending the distribution of grazing privileges will depend either upon building up increased carrying power through skillful range management or upon making room for new applicants in one way or another under the established procedure of the present regulations.

In some localities changes in economic conditions may have occurred during the past few years which will call for some adjustments at the close of the present term-permit period. This situation is being studied in order to meet the needs, so far as they can be foreseen, for the next period.

With the exception of certain areas where the extent of reductions in numbers of stock is uncertain, it is expected that the number under term permits for the next 10-year period will be approximately the same as is shown in table 11:

TABLE 11.—*Livestock allowed under term or 10-year permits on the western national forests, calendar year 1932*

Region	Number of stock under term permits		Percent of total	
	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats
1.....	58,445	262,584	40	36
2.....	168,572	667,278	41	47
3.....	149,601	298,129	51	61
4.....	270,746	2,262,152	78	90
5.....	48,169	125,897	32	32
6.....	24,019	352,578	23	43
Total.....	719,552	3,968,618	50	63

Important as may be, from the individual's standpoint, the mechanics by which stability in range use is secured, stabilized forage production is of far greater importance. That, of course, requires that every area not now supporting its maximum stand of usable vegetation be brought to full productivity. Then the all-absorbing question becomes how utilization can most advantageously be adjusted to the requirements of the vegetation and related resources. The nature of the problem calls for careful surveys and the development of long-time land-use plans. These plans contemplate full and complete use of the various resources, with impairment to none. In this field the Forest Service has made great progress. Its completed range-management plans are on a scale unknown elsewhere in the civilized world. The ultimate verdict upon those plans will be pronounced by future generations, but already there is clear evidence that planning, the use of scientific data, and application of the resulting knowledge by trained men warrant the prediction of complete success. The accomplishments year by year are in some cases difficult to determine, but the gradual progress of the years builds a record that might well be emulated by the owners of other lands of a similar character.

But stability of range use on the national forests cannot hope to remedy all the economic ills of the western livestock industry. It is a small, though important, part of what should be fitted into a broad program of better planning for the industry. In this the Government has a responsibility for its own land which should be met through quick and appropriate action for public domain range restoration.

In addition to the mechanics heretofore discussed and the means of securing continuity of forage production, there are still two main points of attack in increasing productivity. First, there must be ample equipment in the form of fences for the control of livestock; water development, so that even utilization of forage can be secured; and many other improvements essential to the application of the plans worked out for the more than 9,000 allotments on the national forests. This work has been proceeding for many years in cooperation with the stockmen, but much still remains to be done. Fast progress is now assured through the activities of the Civilian Conservation Corps and the allotment of funds under the public works program.

Table 12 shows the projects constructed during the fiscal year 1932.

TABLE 12.—*Range improvements constructed on national forests, fiscal year 1932*

Region	Fences		Corrals		Driveways		Bridges		Water developments		Miscellaneous	Total cost
	Miles	Cost	Number	Cost	Miles	Cost	Number	Cost	Number	Cost	Cost	
.....	67	\$15,774	.....	\$49	21	\$2,287	.....	.....	206	\$13,779	\$516	\$32,405
.....	47	14,337	2	446	2	237	1	\$200	40	3,853	8,608	27,681
.....	180	46,146	.....	4	.....	.....	.....	.....	4	1,409	2,180	49,739
.....	34	11,036	7	520	.....	127	1	167	118	22,794	4,375	39,019
.....	21	4,832	4	545	3	349	.....	.....	75	13,316	2,727	21,769
.....	39	7,228	5	596	11	190	1	20	124	8,142	5,960	22,136
Total	388	99,353	18	2,160	37	3,190	3	387	567	63,293	24,366	192,749

The second point of attack in increasing range productivity is to reduce to a minimum the annual losses of livestock from all causes. As indicated in table 13, these constitute a drain on the livestock industry, which should be eliminated by the application of known methods. Not only will reduction of losses increase benefits to stockmen, but in many instances successful use of ranges is largely dependent upon successful control of poisonous plants.

TABLE 13.—*Livestock losses, 1932*

CATTLE AND HORSES

Region	Poisonous plants		Predatory animals		Disease		Other		Total	
	Number	Value	Number	Value	Number	Value	Number	Value	Number	Value
1.....	316	\$12,640	8	\$320	134	\$5,360	716	\$28,640	1,174	\$46,960
2.....	2,856	114,240	59	2,360	1,337	53,480	1,592	63,680	5,844	233,760
3.....	613	24,520	859	34,360	651	26,040	3,439	137,560	5,562	222,480
4.....	1,581	63,240	118	4,720	233	9,320	1,651	66,040	3,583	143,320
5.....	533	21,320	57	2,280	344	13,760	1,267	50,680	2,201	88,040
6.....	213	8,520	22	880	112	4,480	528	21,120	875	35,000
Total.....	6,112	244,480	1,123	44,920	2,811	112,440	9,193	367,720	19,239	769,560

SHEEP AND GOATS

1.....	3,106	\$15,530	6,898	\$34,490	1,290	\$6,450	10,699	\$53,495	21,993	109,965
2.....	8,752	43,760	12,124	60,620	3,280	16,400	10,218	51,090	34,374	171,870
3.....	1,190	5,950	3,334	16,670	708	3,540	2,971	14,855	8,203	41,015
4.....	9,920	49,600	30,294	151,470	5,402	27,010	17,203	86,015	62,819	314,095
5.....	2,235	11,175	3,615	18,075	878	4,390	4,162	20,810	10,890	54,450
6.....	3,093	15,465	6,309	31,545	3,105	15,525	9,201	46,005	21,708	108,540
Total.....	28,296	141,480	62,574	312,870	14,663	73,315	54,454	272,270	159,987	799,935

RECREATION AND GAME

Each year adds increased emphasis to the fact that public use of the national forests for a wide variety of forms of outdoor recreation is a major use and service, for which adequate provision should be made in all plans of administration and management. The social values and beneficial consequences of such use are incalculable. The estimated number of national-forest visitors in the calendar year 1932 shows, as did those for the two preceding years, that in times of economic depression and unemployment, as well as in times of prosperity, large numbers of people find in the national forests the popular, democratic, inexpensive, and relatively unrestricted types of outdoor recreation they most desire. Nor are the benefits wholly local; parked upon the camp grounds of a single forest may be found automobiles from almost every State in the Union and from some of its insular possessions. The economic existence of hundreds of communities along the routes leading to the national forests, or within their borders, depends in large measure upon the continuance and expansion of such recreational use, which also creates markets for the processed or manufactured products of all parts of the Nation. Full development of the scenic, inspirational, and recreational qualities of the national forests is dictated by all considerations of social service and economic well-being.

Estimates, more carefully made than ever before and with every effort to get rid of duplications, indicated that the visitors to the national forests during the calendar year approximated 35,718,434; a gain of 3,489,821 persons, which, however, was less than the increase in number of motorists, there being a small decline in the numbers of other classes. Specifically, there were 530,182 special-use permittees and guests; 1,138,634 hotel and resort guests; 2,178,231 campers; 4,011,646 picnickers; 6,407,128 motorists, horsemen, hikers, etc., who toured the forests primarily to enjoy their scenery; 37,150 unclassified; and 21,415,463 motorists, etc., who merely passed through the forests en route to their destinations but who nevertheless enjoyed in some degree the scenic charm of the forests and the facilities made available for recreationists.

Many of the forests are highly inflammable during the summer season, and many of the watersheds within the forests are used by municipalities as sources of water supply. The best protection to public property and public health against the hazards attendant upon the presence of such large numbers of persons is secured by the provision of camping and sanitary facilities which encourage voluntary concentration in areas of minimum risk. To that end, 1,984 national-forest public camp grounds have been established and at least partially equipped with simple facilities for sanitation and fire control. Expenditures for that pur-

ose during the year totaled \$57,303, of which \$3,460 was contributed by co-operators. The total cumulative cost of this work has been \$487,840, of which \$5,087 has been contributed by other agencies, in money, materials, or services.

Table 14 shows that for a majority of the species of big-game animals the number increased.

TABLE 14.—*Number of big-game animals on national forests, by States, estimated as of December 31, 1932*

State	Antelope	Bear		Deer	Elk	Moose	Mountain goats	Mountain sheep
		Black or brown	Grizzly					
Alabama				750				
Alaska		6,200	14,500	50,600	25	390	10,000	1,525
Arizona	5,810	596	5	87,700	5,680			280
Arkansas		6		1,925				
California	1,610	9,961		278,660	150			424
Colorado	112	2,860	3	47,780	13,610			3,341
Florida		255		2,500				
Idaho	2,734	4,903	50	57,365	9,282	421	2,886	1,654
Louisiana				10				
Michigan		185		5,850	4	1		
Minnesota		1,580		9,845	22	2,770		
Mississippi				6				
Montana	876	5,859	421	50,610	16,115	1,820	4,220	1,883
Nebraska				155				
Nevada	195	2		9,155	40			146
New Hampshire		780		4,050		10		
New Mexico	1,013	915	7	100,400	974			114
North Carolina		310		5,965	17			
Oklahoma		4		400	365			
Oregon	255	6,143	1	88,350	10,450			60
Pennsylvania		125		7,000	3			
South Dakota				4,765	315		12	
Tennessee		40		440				
Utah		516	4	67,420	2,940			157
Vermont		20		100				
Virginia		495		180	40			
Washington		5,641	7	35,990	9,379	1	4,618	6
West Virginia		300		125				
Wisconsin		74		7,900				
Wyoming	545	1,561	166	20,550	34,445	2,441		2,915
Total, 1932	13,150	52,331	5,164	946,546	103,856	7,854	21,736	12,505
Total, 1931	12,725	50,596	3,747	969,330	96,905	7,835	22,262	12,555

¹ Includes Alaska brown bear.

Mountain sheep and mountain goats, however, just about held their own. This is no doubt due to many factors, none of which is clearly understood although disease, predators, and winter feed may be assumed to be the controlling ones. The situation with these animals clearly presents the need of more thorough research, in which the various Federal bureaus and State agencies concerned should take the lead.

With all game species, excepting mountain sheep and goats, the problems are being more clearly visualized and advances made toward their solution. Protection from illegal killing, predators, starvation, etc., while important, is now being fitted into its proper place in broad plans dealing with range and animal productivity. The diversity of interests sometimes makes the development of plans most difficult; but by the constant development of facts and cooperation with the various agencies headway is being made in land-use programs. Control of factors detrimental to wild life, involving the adjustment of other uses, forces the exercise of expert knowledge and the use of such scientific data as are now available. Nowhere do we find, however, greater need for the fully qualified land manager than on areas where game, recreation, timber, grazing, and perhaps other uses are involved.

Planning the proper use of land is one thing; getting those plans into effect is entirely another question. As it pertains to wild life, the latter is much more difficult. Timber cutting, grazing of forage, or the use and occupancy of land for other purposes are all under the direct control of the Forest Service. Not so with game; the Forest Service may proceed with the development of plans, but unless the State game laws governing bag limits, seasons, etc., on game

conform to the requirements of a plan developed from biological and other facts no constructive advance can be maintained. The Forest Service views with considerable satisfaction recent evidences of a better appreciation of the problem and a better and larger program of cooperation.

WATER POWER

The economic depression has markedly affected the use of electric energy from plants now operating and the estimates of future growth in market requirements. There was a big falling off during the year in the number of proposed developments. This reduced the demands on the time of Forest Service personnel for making investigations and reports on applications to the Federal Power Commission for permits or licenses. On the other hand, applications for amendments to existing permits or licenses have been more numerous and time consuming than usual.

At the end of the year the Forest Service, at the request of the Federal Power Commission, was supervising the operations of 371 permittees or licensees under the Federal water power act, an increase of 17 during the year. The Commission requested the Forest Service to make investigations and reports in 4 cases, and 48 reports were made. The Forest Service also made two valuation or appraisals. The Power Commission during the year received 38 applications for permits or license. Of these 28, or 74 percent, involved the use of national forest land.

As in previous years, fewer permits issued by the Department of Agriculture were in effect at the end of the fiscal year than at the beginning. The net reduction was 12. On June 30, 1933, 210 of these permits were in effect. They consisted of 99 permits or easements for water-power projects, with an average low-flow output estimated at 515,966 horsepower, and 111 permits or easements for transmission lines only, with a total length of 905.56 miles within the national forest boundaries. Of the power projects, 52, with an estimated output of 490,811 horsepower, and of the transmission line cases, 88, with a length of 738.13 miles within the forest boundaries, require the payment of an annual rental. The estimated average output of the power projects covered by free permits was 531 horsepower. The transmission lines under permits providing for no annual rental cover a length of 167.43 miles within the forests.

The administrative instructions for handling the waterpower work were thoroughly reviewed and very largely revised. Much time was devoted to checking up on the compliance of Department of Agriculture permittees with the permit provisions. Conflicts between water power and other uses of forest land particularly for highways, continued on a large scale. Much time and thought were given to this matter, especially in cooperation with the Power Commission, but a determination of general policy and principles has not yet been made.

The slowing down in the demand for power permits and licenses made available some time of engineers which it was planned to utilize in making a thorough field study of forest lands under power classification or withdrawal and in inventorying the waterpower resources of the forests and determining what lands have greatest value for power uses. The time requirements of the emergency conservation work, however, prevented even a start on this work.

ROADS AND TRAILS

Table 15 shows the present status of the transportation system planned for the national forests. Roads required for public travel, as well as for the protection, administration, development, and utilization of the forests, are included. The roads required primarily for public travel are the forest highways. Table 16, 17, and 18 show by States the mileage constructed and maintained, the expenditures, and the apportionments of the various road funds; and table 19 shows the condition of these funds at the close of the year.

TABLE 15.—*Classification of mileage in forest road and trail system and expenditure required to complete the system to a satisfactory standard*

Class	Miles				Expenditure required to complete
	Total	Satisfactory standard	Unsatisfactory standard	Nonexisting	
Forest highways.....	16,852	6,728	8,910	1,214	\$166,050,700
Forest development roads.....	75,212	30,350	19,440	25,422	45,076,100
Total roads.....	92,064	37,078	28,350	26,636	211,126,800
Trails.....	149,838	122,450	12,073	15,315	3,137,410
Total.....					214,264,210

TABLE 16.—*Construction, improvement, and maintenance of roads and trails from forest-road appropriations and other Federal and cooperative funds, by States, June 30, 1933*

State	Fiscal year 1933				Total to June 30, 1933		Expenditures to June 30, 1933		
	Constructed		Maintained		Constructed		Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails	Roads	Trails			
	Miles	Miles	Miles	Miles	Miles	Miles			
Ala.....	4.1		182.8		71.4		\$192,994.87	\$25,278.16	\$218,273.03
Alaska.....	3.0	69.6	242.1	494.9	250.0	587.2	6,537,803.23	377,947.35	6,915,750.58
Ariz.....	493.1	185.0	3,586.0	2,554.5	2,463.3	1,924.6	8,245,592.14	1,137,372.19	9,382,964.33
Ark.....	75.2		485.5	571.4	717.0	571.4	1,870,692.94	135,806.97	2,006,499.91
Calif.....	873.0	125.1	10,963.0	20,838.0	5,430.1	11,523.7	21,922,895.25	7,478,885.72	29,401,780.97
Colo.....	64.4	222.9	1,184.1	11,330.0	1,639.7	11,770.5	9,623,952.55	1,031,917.40	10,655,869.95
Fla.....	250.6		368.5		616.7		727,214.06	146,179.84	873,393.90
Ga.....	41.7	22.5	148.3	329.4	164.1	351.9	681,281.10	82,949.62	764,230.72
Idaho.....	708.7	1,798.0	3,895.7	28,186.0	3,374.1	20,388.1	20,378,132.12	1,888,154.58	22,266,286.70
Ill.....							441.41		441.41
Kans.....					3.4		2,111.54		2,111.54
Ky.....							808.72		808.72
La.....	63.7		90.2		153.9		48,853.58		48,853.58
Maine.....	3.0		8.5	74.0	10.4	67.2	81,091.87		81,091.87
Md.....							70.05		70.05
Mich.....	155.7		594.1		626.4		358,490.99	44,966.98	403,457.97
Minn.....	69.0		310.0	1,178.1	413.7	585.6	1,184,463.99	278,510.83	1,462,974.82
Miss.....	9.0				9.0		9,759.09		9,759.09
Mont.....	122.1	1,216.1	3,016.5	21,097.8	1,336.5	10,411.0	12,356,926.14	657,532.88	13,014,459.02
Neb.....			75.9		51.5		119,481.03	990.80	120,471.83
Nev.....	30.5	5.3	334.0	1,183.2	558.9	920.4	2,107,475.07	168,271.95	2,275,747.02
N.H.....	10.0	27.5	308.5	580.0	71.6	580.0	600,987.33	95,949.70	696,937.03
N.J.....							217.71		217.71
N.Mex.....	180.4	36.3	1,923.6	3,377.5	1,361.5	1,634.8	6,246,452.10	330,825.54	6,577,277.64
N.Y.....							81.32		81.32
N.C.....	31.4	41.8	236.4	676.8	240.7	676.8	1,065,652.18	449,402.16	1,515,054.34
N.Dak.....					1.0		57.75		57.75
Okla.....	16.7		38.0	1.5	51.4	16.5	124,062.84	14,512.08	138,574.92
Oreg.....	553.5	634.5	9,444.1	15,524.0	4,756.5	8,666.4	18,695,93.59	7,893,300.39	26,589,235.98
Pa.....	4.9	178.8	97.6	23.0	72.0	201.8	322,081.66	42,185.50	364,267.16
P.R.....			4.6	36.3	6.6	36.3	35,445.02	550.00	35,995.02
S.C.....			13.0	18.2	6.3	18.2	114,672.71	15,659.81	130,332.52
S.Dak.....	14.6		281.2	54.5	355.3	85.1	1,198,650.54	244,046.11	1,442,696.65
Tenn.....	35.4	8.5	131.6	817.8	134.3	817.8	694,741.79	189,884.30	884,626.09
Utah.....	112.5	32.0	1,136.5	4,486.5	1,323.7	3,725.4	4,929,084.55	965,621.83	5,894,706.38
Vt.....	2.0		10.5	37.9	2.0		16,811.02		16,811.02
Va.....	106.6	10.1	224.7	917.3	243.1	927.4	936,880.80	106,400.35	1,043,281.15
Wash.....	256.0	766.7	2,470.0	14,117.0	1,781.7	8,502.0	12,351,723.70	1,713,530.02	14,065,253.72
W.Va.....	81.0	80.0	111.5	476.4	201.6	560.2	541,680.97	38,159.30	579,840.27
Wis.....	59.5		130.0		178.2		132,886.84	1,820.00	134,706.84
Wyo.....	23.4	53.0	972.0	6,256.2	1,098.4	2,541.3	6,112,646.93	397,382.96	6,510,029.89
Total.....	4,454.7	5,513.7	43,019.0	135,238.2	29,876.0	97,091.6	140,571,285.06	25,953,995.32	166,525,280.38

TABLE 17.—*Distribution among the States of the road and trail apportionments for the fiscal year 1934*

State	10 percent fund	Forest high-ways ¹	Improvement ¹	Total
Alabama.....	\$58.94	\$14,732	\$49,000	\$63,790.94
Alaska.....		350,000	60,000	410,000.00
Arizona.....	26,669.99	980,996	383,000	1,390,665.99
Arkansas.....	1,572.16	192,527	267,000	461,099.16
California.....	44,231.88	2,351,177	2,972,000	5,367,408.88
Colorado.....	34,297.66	1,217,346	274,000	1,525,643.66
Florida.....	1,479.52	63,763	19,000	84,242.52
Georgia.....	255.03	46,542	94,000	140,797.03
Idaho.....	26,041.84	1,710,825	1,052,000	2,788,866.84
Illinois.....		15,675		15,675.00
Kentucky.....		24,691	143,000	167,691.00
Louisiana.....	12.38	23,297	72,000	95,309.38
Maine.....	36.40	5,597	8,000	13,633.40
Michigan.....	234.39	94,966	168,000	263,200.39
Minnesota.....	968.06	157,300	150,000	308,268.06
Mississippi.....		34,709	93,000	127,709.00
Missouri.....		21,488		21,488.00
Montana.....	16,308.75	1,344,773	465,000	1,826,081.75
Nebraska.....	963.76	16,251	8,000	25,214.76
Nevada.....	6,496.97	312,310	6,000	324,806.97
New Hampshire.....	545.10	86,628	85,000	172,173.10
New Mexico.....	9,503.29	687,273	333,000	1,029,776.29
North Carolina.....	2,037.09	81,326	373,000	456,363.09
Oklahoma.....	464.00	22,078	24,000	46,542.00
Oregon.....	21,750.46	2,186,449	1,064,000	3,272,199.46
Pennsylvania.....	452.02	41,976	66,000	108,428.02
Puerto Rico.....	15.82	1,953	11,000	12,968.82
South Carolina.....	65.25	20,025	62,000	82,090.25
South Dakota.....	5,507.48	130,565	60,000	196,072.48
Tennessee.....	496.58	59,776	124,000	184,272.58
Texas.....		14,325		14,325.00
Utah.....	17,849.81	559,047	212,000	788,896.81
Vermont.....	33.80	8,334	49,000	57,367.80
Virginia.....	851.97	73,068	112,000	185,919.97
Washington.....	24,422.30	1,207,246	735,000	1,966,668.30
West Virginia.....	186.56	44,812	135,000	179,998.56
Wisconsin.....	26.23	60,442	109,000	169,468.23
Wyoming.....	16,508.81	735,712	163,000	915,220.81
Total.....	260,344.30	15,000,000.00	10,000,000	25,260,344.30

¹ \$15,000,000 forest highways and \$10,000,000 improvement made available under sec. 205 of the National Industrial Recovery Act.

TABLE 18.—*Distribution among the States of the total road and trail apportionments, including those for the fiscal year 1934*

State	10 percent fund	Section 8	Federal forest road construction	Forest highways ¹	Forest road development	Improvement ²	Grand total
Alabama.....	\$1,027.90	\$15,456.04	\$1,922.31	\$74,506	\$87,184	\$80,077.06	\$260,173.31
Alaska.....	170,809.45	470,963.60	203,229.50	6,645,184	249,114	60,000.00	7,799,300.55
Azona.....	679,493.56	677,956.45	490,434.11	5,804,572	1,625,371	929,273.39	10,207,100.51
ansas.....	132,065.39	175,126.19	128,423.38	863,318	625,045	562,897.47	2,486,875.43
California.....	1,733,154.91	1,464,333.82	1,201,431.20	13,980,709	5,059,565	4,490,217.76	27,929,411.69
Colorado.....	810,895.24	770,948.34	784,259.55	6,862,938	1,892,233	459,629.09	11,580,903.22
Florida.....	46,053.86	119,528.14	21,534.94	293,622	171,835	159,417.47	811,991.41
Georgia.....	13,032.00	52,393.57	130,443.73	194,253	213,509	227,229.53	830,860.83
Idaho.....	1,014,099.53	1,176,750.85	1,337,004.17	10,318,588	7,275,982	2,879,886.55	24,002,311.10
Illinois.....				20,520			20,916.00
ansas.....	1,867.27						1,867.27
Indiana.....	722.72			24,691	86	143,000.00	168,499.72
Mississippi.....	57.62			31,090	10,586	110,132.47	151,866.09
aine.....	3,980.03	32.41	3,738.77	28,332	28,866	29,909.56	94,858.77
aryland.....	70.05						70.05
Michigan.....	4,310.72	115.63	3,000.00	191,691	122,644	332,507.86	654,169.21
Minnesota.....	45,013.65	8,036.36	108,352.03	669,521	374,148	280,348.59	1,485,419.63
Mississippi.....				40,276	5,487	101,598.45	147,361.45
Missouri.....				21,488			21,488.00
Montana.....	626,542.36	762,523.77	764,035.26	8,169,410	3,588,808	1,116,377.24	15,027,696.63
Nebraska.....	20,822.93	18.98		98,500	32,135	8,578.27	160,633.45
Nevada.....	189,508.66	192,989.88	81,491.85	1,918,765	162,343	51,878.18	2,596,976.57
New Hampshire.....	53,221.59	7,165.35	10,941.30	416,463	176,371	141,487.05	805,649.29
New Jersey.....	118.99				83		201.99
New Mexico.....	369,957.01	426,086.04	518,426.97	4,200,536	1,244,449	741,824.28	7,501,279.30
New York.....	4.00				20		24.00
North Carolina.....	40,993.19	86,336.41	176,466.28	311,105	342,843	565,530.92	1,523,274.80
North Dakota.....	45.75	7.00					52.75
Alabama.....	11,163.75	65.49	2,775.17	62,385	42,705	59,700.19	178,794.60
regon.....	1,071,397.44	1,428,785.95	1,013,981.59	12,580,038	5,118,492	1,940,916.07	23,153,611.05
Pennsylvania.....	5,889.32	7,724.04	21.42	146,039	153,145	145,976.40	458,795.18
Puerto Rico.....	150.44	7.00	3,343.09	11,841	17,005	15,714.52	48,061.05
South Carolina.....	3,253.68	402.10	48,028.61	45,585	49,408	62,171.08	208,848.47
South Dakota.....	193,026.19	87,106.45	78,652.52	770,493	228,313	93,879.18	1,451,470.34
Tennessee.....	21,120.59	106,854.56	27,967.79	252,355	237,917	224,304.31	870,519.25
Texas.....				14,325			14,325.00
Utah.....	435,176.35	464,918.34	512,489.56	3,424,581	734,388	395,090.76	5,966,644.01
Vermont.....	34.40			13,740	829	59,778.15	74,381.55
Virginia.....	48,165.76	58,390.16	71,784.26	329,588	340,797	266,268.85	1,114,994.03
Washington.....	704,313.75	958,090.33	732,302.49	6,982,812	3,847,220	1,596,091.47	14,820,830.04
West Virginia.....	6,331.44	12,830.41	5,049.24	148,235	193,779	343,604.94	709,830.03
Wisconsin.....	63.25			83,493	29,754	207,415.88	320,726.13
Wyoming.....	479,970.56	468,056.34	538,468.91	4,454,512	1,217,145	265,815.87	7,423,968.68
Total.....	8,937,925.30	10,000,000.00	9,000,000.00	90,500,000	35,500,000	19,148,528.86	173,087,032.43

¹ Includes \$3,000,000 appropriated for emergency highways within national forests, fiscal year 1931, and \$100,000 emergency forest highways, fiscal year 1933, and \$15,000,000 for forest highways under the provision of sec. 205 of the National Industrial Recovery Act.

² Includes (a) road and trail actual expenditures from Agricultural Appropriation Act annual funds and (b) \$10,000,000 improvement funds under the provisions of sec. 205 of the National Industrial Recovery Act.

TABLE 19.—*Condition of forest-road funds on June 30, 1933*

Fund	Appropriations	Expenditures	Balance
10 percent.....	\$8,677,581.00	\$8,282,223.87	\$395,357.13
Sec. 8.....	10,000,000.00	10,000,000.00	-----
Federal forest-road construction.....	9,000,000.00	9,000,000.00	-----
Forest highways ¹	68,960,000.00	65,272,239.19	3,687,760.81
Forest-road development.....	35,500,000.00	34,150,477.20	1,349,522.80
Improvement ¹	9,148,528.86	9,148,528.86	-----
Total.....	141,286,109.86	135,853,469.12	5,432,640.74

¹ Includes emergency funds.

The last two agricultural appropriation acts have limited to \$350,000 the expenditure in Alaska from the forest-highway appropriation. Previously the Alaska apportionment was approximately one tenth of each forest-highway authorization.

Since no legislation was enacted authorizing forest-road and trail appropriations for the fiscal year 1934 under section 23 of the Federal Highway Act, appropriations for the regular forest-highway and forest-road-development funds were limited to the balance left in the 1933 \$12,500,000 authorization. Only \$2,082,600 now remains unappropriated, practically all of which has been obligated for construction and maintenance projects.

On March 21, 1933, the President issued instructions to "cease obligating all or any part of the unobligated funds which involve construction work." This caused the immediate cessation of all work for which financial obligations had not been entered into. After discussions and conferences the Bureau of the Budget decided that a total of \$2,705,045 was affected. It was made up of \$1,595,243 forest-highway funds, \$287,900 forest-road-development funds, \$548,100 emergency-improvement funds, \$180,000 10-percent funds, and \$93,800 improvement funds. On June 13 word was received that the President had lifted the stop order on forest highways and authorized the resumption of approval of road projects and of entering into contracts.

On June 16 the National Industrial Recovery Act was signed. It provided under section 205, that "not less than \$50,000,000 of the amount made available by this act shall be allotted for (a) national forest highways, (b) national forest roads, trails, bridges, and related projects, (c) national park roads and trails in national parks owned or authorized, (d) roads on Indian reservations, and (e) roads through public lands, to be expended in the same manner as provided in paragraph (2) of section 301 of the Emergency Relief and Construction Act." Allotments of \$15,000,000 for national-forest highways and \$10,000,000 for national-forest roads, trails, bridges, and related projects have been made. Of the \$15,000,000, \$350,000 was apportioned to Alaska and the rest to the State and Puerto Rico on an area and value basis as prescribed in the rules and regulations for administering the forest-highway fund. This money will be programmed to individual road projects by the Secretary of Agriculture after receiving the recommendations of the interested State highway commissions and representatives of the Bureau of Public Roads and the Forest Service. The \$10,000,000 fund was divided among States in accordance with the regional foresters' estimates of needs during the next 2 years for the immediate construction and maintenance of improvement roads, trails, and bridges. This work will be in addition to that done by the Civilian Conservation Corps, which in many cases cannot be utilized on projects of the highest priority because of the limitations necessarily imposed by the size of the camps and whole plan of organization.

The creation of the Conservation Corps made available for construction and improvement work a large though inexperienced force of young men, who required much supervision and instruction. All told, 597 camps of 200 men each were located on the national forests. The services of the corps were largely and extensively utilized in the construction and improvement of forest truck and horse trails. After making available all the equipment which could be spared from the regular Forest Service work and surplus equipment in other departments about \$1,000,000 had to be spent for the purchase of tractor trail builders tractors, graders, and compressors.

MAPS AND SURVEYS

For administrative use the Forest Service published 19 quarter-inch scale maps, half-inch scale maps, and 4 inch-scale maps of the individual national forests. There were also published 2 maps to accompany Presidential Executive Orders, small editions of miscellaneous maps, charts, tables, graphs, and illustrations, and 3 United States Geological Survey quadrangles showing in color tints the vegetative types.

The Forest Service personnel completed surveys on mapping projects covering about 1,500 square miles. This mapping was done on scattered areas, to the accuracy and scale required to meet special requirements of forest administration. Drainage maps covering approximately 3,000 square miles were completed by aerial methods.

RESEARCH

Some curtailment of the regular research activities was necessitated by the falling-off in the available funds shown in table 20. A greater cause of interruption in the orderly prosecution of the long-time program was the demand made upon the research organization by the Copeland report. The execution of this monumental task was a Service-wide undertaking, but its planning and direction and the largest share in the actual work fell to the Branch of Research. In the assembling of the field data the 11 forest and range experiment stations played the leading part. Organization of the entire inquiry and preparation for obtaining the necessary data had been completed before the opening of the fiscal year. The raw material for the report reached Washington in September and October. To assist in its digestion, in the working up of the factual sections, and in the final formulation of the findings and recommendations derived from them, a considerable number of the ranking officers of the Service field force and the experiment-station staff members were brought into Washington for varying periods. An enormous amount of overtime work was done, and the whole project was carried on under high pressure up to the time of its termination in March. Only through the loyal and devoted cooperation of many men and women both of the professional and administrative and of the clerical force was the completion of this great task within the permissible time limit made possible. The funds made available for research activities under various appropriation items for the fiscal year 1933 are shown in comparison with the amounts for 1932 and 1934 in table 20.

TABLE 20.—*Appropriations available for research for 1933 as compared with those for 1932 and 1934*

Class of research	1932	1933 ¹	1934 ¹
Forest-management investigations.....	\$562,000	\$497,181	\$378,468
Forest-products investigations.....	641,300	556,425	435,407
Range investigations.....	130,000	111,922	76,820
Forest-economics studies.....	75,000	64,692	46,092
Forest survey.....	200,000	157,221	122,963
Forest-taxation study.....	70,200	38,023	25,267
Forest-insurance study.....	10,000	12,000	7,840
Erosion stream-flow studies.....	100,000	82,973	64,386

¹ The amounts shown in these 2 columns are the amounts made available by the Agricultural Appropriations Act less the amounts withheld under the provisions of the Economy Act and by the Bureau of the Budget.

FOREST ECONOMICS

The preparation of the portions of the Copeland report falling particularly within the field of forest economics was the outstanding activity of the year in that field. The work done included: A general review of the national significance of and reasons for forestry; a survey of the status of private forestry and opportunity for its further development; an analysis of the theories and principles of public regulation of private forests, its status in other countries, and a possible program for public regulation in the United States; an examination of the need for public assistance in organizing credit facilities for forest enterprises; a study of the national timber requirements, together with an analysis of world requirements in relation to United States timber supplies and needs; and a comprehensive

investigation and analysis of the best data available on the present and potential forest resources of the United States and of individual forest regions, including forest areas, timber supplies, rates of depletion and growth, ownership of forests and related matters. These contributions have all been published in the form of separates.

The results of the exhaustive time and cost studies, completed in 1932, of virtually all types of logging equipment and methods employed in the Douglas fir region were interpreted and made available to the industry in various ways, and a report was completed for publication. By changes in methods it is possible in many instances to save \$2 or more per thousand board feet in the cost of logging, while also perpetuating and improving the forest. A second report, correlating these and other findings with the variations in value which are determined by age and size of timber, is being prepared. The facts developed by these studies are of the utmost importance for improved forest management in the Douglas fir region.

The continuing investigation of the financial aspects of forestry in the southern pine region brought out strongly the financial and silvicultural advantages of selective logging in virgin and second-growth stands of loblolly and shortleaf pines and hardwoods. Further evidence was developed of the financial practicability of private forestry on many tracts in the region.

The study of "the new public domain", that is, forest land which is reverting to public ownership through tax delinquency, was continued in the Lake States, the South, and the Pacific Northwest. A chapter on tax delinquency and the cut-over-land problem in northern Minnesota was contributed to the book on Taxation in Minnesota published during the year by the University of Minnesota, and the data were also used by the Governor's committee on land utilization. Study was begun of the Upper Peninsula of Michigan, where the area of delinquent land is large and increasing. In Arkansas, a study of tax delinquency in relation to land use in representative counties was completed in cooperation with the State university. Investigations in the Douglas fir region of western Oregon and Washington showed that the extent of reversion to public ownership is far greater than has been supposed. Tax delinquency and land abandonment there are causing acute difficulties to agencies which depend on tax revenues, and the delinquent areas are becoming a serious hazard to contiguous timber properties.

Actuarial studies of the problems and possibilities of forest-fire insurance in the Douglas fir region and in the ponderosa pine region of the Northwest were completed. Records of stumpage and log prices in all forest regions for the years 1931-32 were compiled and prepared for publication.

FOREST SURVEY

The field work and most of the office work on the inventory phase of the forest survey of the Douglas fir region were completed. This makes available for the first time a complete set of data accurately localized by counties and by major ownership groups, showing the volume of timber by species and the acreage of all classes of forest growth and of cut-over and burned-over forest land. An investigation of the average rate and trends of depletion of both old and young timber by fire, cutting, and other causes was practically completed. Work is also well under way on a study of the region's requirements for forest products.

In the South, the inventory of the Delta hardwood unit of Mississippi, covering 4,420,000 acres, was completed and is being prepared for publication. Field work was also completed for the northern Mississippi unit of upland pine and hardwoods (8,154,000 acres), and was commenced in the central Mississippi unit. In all, approximately half of the State has been surveyed.

The survey of several counties in northern Idaho was virtually completed. Surveys of two counties in Michigan and one in Wisconsin, aggregating nearly 2,000,000 acres, were made in cooperation with the State agencies. These surveys include forest maps, timber estimates, and studies of growth rates. In California, the mapping of forest-cover types was continued in cooperation with the national-forest administrative force, the State, the United States Geological Survey, and the National Park Service. Maps of four quadrangle units, on a Geological Survey base, were published, and others are in preparation.

Studies of the requirements of wood for urban construction were made for a number of representative cities well distributed in nearly all of the different forest regions.

FOREST TAXATION

In view of the widespread interest in the problems of forest taxation and the many requests for suggestions as to desirable changes in systems of forest taxation, summarized conclusions and recommendations of the Forest Taxation Inquiry with regard to four specific forms of forest taxation were made available as a mimeographed progress report (no. 18), which was given wide distribution.

FOREST MANAGEMENT AND PROTECTION INVESTIGATIONS

During the year many agencies, public and private, obtained help from the forest experiment stations. Administrative organizations were aided in meeting problems due to curtailment of funds, or regarding the best use of funds for improvement programs. Many such problems arose in connection with planning for the work of the Civilian Conservation Corps.

FIRE-CONTROL RESEARCH

Continued studies relating to fire control furnished a more complete basis for protection planning. Previous investigations had established bases for determining the relative damages caused by fire, the rate of spread of fire, the probability that fire will start, and the difficulty of fire suppression. A study of the detection system used on the national forests disclosed that extensive areas on which fires of large size are often not sufficiently commanded by the look-out stations. A method was devised for locating blind areas and ascertaining the relative value of different look-out points. Many forest officers were given special training in this method on the experimental forests, and are now putting it into practice. In one region, before any look-out house is erected the plans for the detection system are reviewed by the forest experiment station.

The present detection system is based on the assumption that the range of dependable vision for look-outs is 15 miles. Observations as to the visibility of some 450 natural targets, made at 15-minute intervals each day throughout the fire season, showed this assumption to be dangerous because of haze, shadow, and drift smoke. Smoke tests disclosed that the character of the background against which a smoke rises influences visibility more than distance. Under ordinary conditions test smokes could consistently be seen quickly only within a distance of 7 miles; but in one case smoke 24 miles distant was discovered in 1.5 minutes, while in another the detection time required for a look-out only 5 miles distant was 13.1 minutes. Many other wide variations in the distance at which fires are visible and the elapsed time before their discovery were revealed.

A method has been worked out for rating fire hazard, taking into consideration the inflammability of the forest type, the quantity and character of the fuels, the slopes, etc., and analysis of the records of thousands of past fires has afforded a determination of the speed of attack necessary, for various degrees of hazard, in order to keep fires small. This is furnishing the basis for the location of many protection roads and trails. It has also been found that without adding any men, roads, or trails, the efficiency of the first line of defense against fire can be increased for the whole of a national forest by from 3 to 8 percent by relocating look-outs and firemen. This has made possible savings amounting to thousands of dollars for a single national forest.

A device called the fire-danger meter has been developed in the Northern Rocky Mountain Region, which gives an integrated rating of the combined effect of fuel inflammability, air humidity, wind velocity, visibility, season of the year, and other factors involved. This makes it possible to determine quickly the probable rate of spread of fire and the administrative action needed to cope with the danger. A practical eye test devised to determine the fitness of candidates for look-out duty has served to weed out those disqualified. The study of the vision of look-out men resulted in the recommendation that all look-outs be furnished with binoculars, and a careful study was made of all available binoculars, with Army and Navy help. The binoculars used by the Navy were found to be the best for the type of work to be performed.

GROWTH AND FOREST-PRACTICES STUDIES

A new method of estimating growth in selectively cut stands promises to prove one of the most far-reaching accomplishments in many years. Developed for ponderosa pine by W. H. Meyer, of the Pacific Northwest Forest Experiment Station, it can probably be applied to other species growing under comparable conditions. It enables the forest manager to calculate how heavily he should cut to obtain the greatest possible subsequent growth, and approximately when he can

cut again. A by product of this study was the discovery that climatic cycles result in wide variations in growth rates, which may seriously disrupt forest-management plans unless proper allowance is made for them.

Results of past investigations in stand-improvement measures, such as thinning and liberation and improvement cuttings, have been drawn upon in developing the Civilian Conservation Corps program. A publication dealing specifically with stand improvement in the eastern hardwood forests was prepared. It set forth what kind of treatment is required for stands in various conditions to make them fully productive, how to choose crop trees to form the nucleus of the future forest, and what procedure to follow in liberating crop trees so that they will produce wood of high quality. Similar publications are in progress on stand sanitation in the eastern forests and on stand improvement in the southern pine region.

Studies in the redwood region of California indicate that under destructive logging and the slash-burning methods now generally used, even planting cannot bring about satisfactory stands of young growth on any large percentage of the logged area. Redwood reproduces well from seed under proper conditions, and it appears feasible to leave seed trees, as a rule; planting should be necessary only where too dense a ground cover has become established to permit natural reseedling.

Data gathered on the viability of seed stored in the heavy litter and duff of the mature forest in the western white pine region of north Idaho showed a germination of slightly more than 40 percent of the seed stored 1 year, 23 percent of that stored 2 years, and 1 percent or less of that stored 3 or more years. Seed of six other species gave less than 1 percent germination after 1 year, and nothing subsequently.

Much of the tree planting on farms in the Central States has been of the valuable black walnut. Tentative conclusions based on work in eastern Illinois are that walnut planting cannot be successful if the subsoil is tight. Poorly drained land is also poor walnut land. The growth of walnuts on brown silt loam was good in contrast with that on black clay loam heavily infiltrated with organic matter.

At the end of the 1932 chipping season the Starke, Fla., branch of the Southern Forest Experiment Station was permanently closed. Here, for 10 years, were conducted most of the turpentine practices investigations in cooperation with various private forest owners. The establishment of the Osceola National Forest with its experimental forest recently provided, makes it possible to correlate the naval-stores investigations with those in other phases of forest management.

EXPERIMENTAL FORESTS AND NATURAL AREAS

Five new experimental forests, ranging in size from 3,400 to 7,000 acres, were formally set aside. All were in the West. The experimental forests are becoming more and more demonstration centers as well. Some serve as training grounds for national-forest personnel in such fields as forest management, stand improvement, fire control, and reforestation. A larger number are needed. The development of a complete system is held back, especially in some of the more valuable forest types, by the absence of suitably located national forests. Particularly needed are experimental forests in the loblolly pine region of the Coastal Plain, the shortleaf hardwoods type of the piedmont region, the white oak-poplar forests of the Cumberland Plateau and the Ozark region, the oak-hickory type of the Central States, and the bottom-land hardwoods type of the Southern States. In the West the greatest need is in the redwood region of northern California and in the spruce-hemlock region of the north Pacific coast. Hope for a partial solution is afforded by the acquisition program now under way in the East.

Five new natural areas were set aside. The smallest area was one of 640 acres of ponderosa pine, and the largest was one of 4,230 acres in the alpine type of the Sierras. So far 18 natural areas have been set aside, of which only 3 are in the East. The eastern national forests are made up mostly of cut-over lands and very little old-growth forest suitable for setting up natural areas has been acquired. The preservation of representative old-growth stands containing such species as tulip poplar, red and white oaks, hemlock, southern pine, cypress, and red gum is greatly to be desired.

EROSION-STREAM-FLOW INVESTIGATIONS

The study of erosion and stream flow made in connection with the Copeland report revealed that practically every part of the country has one or more serious problems to meet relating to such matters as water for domestic and industrial purposes and irrigation, water power, navigation, floods, and soil erosion. Marked changes are taking place in the regimen of many streams. Undesirable soil movement is taking place on great areas of watershed land. Both are largely the result of improper use of forest, range, and farm land. Almost three fourths of

The total forest area of the United States was classified as having major or moderate influence on watershed values. The varied and complex influences of climate, forest type and condition, and character of soil on stream flow and on erosion must be carefully determined if forest-land management is to meet watershed-protection requirements.

Application of research results was given great impetus during the year. The Civilian Conservation Corps has 97 erosion-control camps on national-forest lands and 104 erosion-control and 20 flood-control camps on State and private lands. The main purpose of this work is to restore forest or other cover where its depletion has been the cause of accelerated erosion or excessive run-off and to supplement this plant cover by check dams or other engineering works to retard water flow and to aid in holding soil. Research results have furnished the basis for much of this work. The studies of the Southern Forest Experiment Station in reclaiming gullies on abandoned farm lands in the South have helped to show how under certain conditions the planting of black locust and other trees and the use of vines and other creeping plants or grasses can be used to check further erosion and to restore the land to a productive condition.

The California Forest Experiment Station made extensive test seedings on a large burn in the southern coastal range of the State. In the fall of 1932 a 219,000-acre fire destroyed the forest and other cover on large portions of the watersheds furnishing the water supply for Santa Barbara, Montecito, Ventura, and many smaller agricultural and other communities. On 4,000 acres 18 tons of seed were broadcast by hand, and on 2,000 acres 9 tons were sown by airplane. The results with Trieste mustard are outstanding. It formed a satisfactory cover on good soils from a sowing of about 4 pounds per acre. Black mustard required 5 pounds per acre more to produce a satisfactory stand. Both species had attained a height of 24 to 40 inches and had produced fruit by the spring of 1933. White and sour clover averaged less than 6 inches in height. Gullies, formed by a heavy January storm before active germination, are now conspicuously marked by dense growth of control plants blocking the run-off channels. Comparable areas seeded by airplane show results in general similar and equal to those on hand-sown areas. There is, however, a decided scarcity of plants on most of the higher and steeper slopes, where violent winds lifted away the loose, fine soil and excessive drying took place.

The California Forest Experiment Station also superintended application of its research results to extensive plantings of brush and other vegetation, supplemented by contour furrows and other aids, on cuts and fills of a number of California mountain highways. Checking the erosion of these exposed slopes reduces both highway-maintenance costs and depositions of eroded material on valuable property.

Study of the relation of roots of native plants to erosion control on the Boise River watershed was continued by the Intermountain Forest and Range Experiment Station, in cooperation with the University of Idaho. Twelve important species of grasses and weeds were excavated and studied intensively. The weed root systems had a low soil-protection value. The one annual grass and the two perennial grasses so far excavated have very fibrous and well-branched roots, which bind the soil immediately around the base of the plant into a firm mat. The perennial grass species have tougher and more extensive roots than the annual cheat grass, but on depleted ranges the latter in favorable years often attains a density of 1,000 plants per square meter, and therefore serves advantageously in holding soil on slopes.

The superior physical condition and consequent permeability of forest soils has been demonstrated for Ohio Valley conditions by studies of the Central States Forest Experiment Station. Samples of the upper 9 inches of soil under several old-growth stands in oak-hickory and other hardwood types were found to be 13 percent lighter at oven dryness than equal volumes of soil from adjacent cultivated fields and a few pastures—indicating more pore space and better tilth. This difference was chiefly in the upper 6 inches. At a 3-inch depth 4 times as much water was absorbed per minute by the forest as by the field soil, and at a 1-inch depth more than 50 times as much.

The ability of old-field pine stands on abandoned fields in the southern Appalachian region to improve the physical structure of the soil and retard surface run-off has been demonstrated at the Appalachian Forest Experiment Station. Abandoned fields required 58 times as long as virgin-forest soil to absorb the same amount of precipitation. Old-field soils supporting a 25-year-old stand of hortleaf pine required only four times as long as virgin-forest soils to absorb the same amount of precipitation. Removal of litter for three successive seasons from an old-growth yellow pine-hardwood stand reduced its porosity and thereby increased surface run-off from 10 to 20 times.

FOREST-PRODUCTS RESEARCH

Logs, lumber, wood, and woods products are staples of American consumption and commerce. Upon the continuance and healthy growth of the commercial demand for forest commodities depend the permanent employment of many thousands of men and the restoration to economic use of vast areas of land now idle. Research in forest products operates toward broadening and stabilizing forest markets. By promoting maximum efficiency in harvesting and using forest stands and adapting them to modern needs, it seeks to safeguard the economic future of forestry. Never was the need greater. Plans for more rational and orderly land use will surely call for an enlargement of forest area and forest productivity as a vital part of the program. If these plans succeed the country may look forward to substantial replenishment of forest raw materials. All the important industries of the country are increasingly recognizing the vital relation of scientific research to modern markets. Now is the time for forest-products research to play its fullest part in shaping nation-wide forestry into a nation-wide economic asset—in showing the way to profitable and permanent standards of logging practice, in securing output of the greatest service value, in adapting the material to advancing engineering, structural, and manufacturing requirements, in developing new uses for wood, and in the formulation of industrial codes that will as far as possible insure these gains in practice.

The Forest Products Laboratory is the center of Forest Service research in the field broadly embraced by forest consumption and markets. The account given below of some of its major activities during the past year will show their important bearing on the present problem of economic forest utilization.

Approximately 70 percent of the country's normal hardwood requirements of 7,000,000,000 board feet a year comes from the South. Logging has cut heavily into the stand of preferred species, leaving large stands of other species unused and many areas in a poor state of productivity. A crisis is in early prospect threatening further loss of employment in hundreds of communities and the passing of thousands of square miles of land from economic production. A broader basis of species utilization is an outstanding need. A great profusion of species is inadequately used, for the most part, because of lack of definite knowledge of their manufacturing and service qualities and a generally low estimate of their commercial possibilities. Regional and national hardwood-producing groups have repeatedly asked for a technical study of the southern species, and the Forest Products Laboratory this year began an investigation of the problem in its various phases, from the growth of the tree to the machine properties of the wood.

A number of forest stands and mill operations in the Gulf States and Arkansas were studied, and some 5,000 growth samples and 10,000 samples of the lumber of 18 lowland hardwoods were collected, along with detailed site descriptions. Information obtained from plants manufacturing furniture, refrigerators, automobile bodies, and other hardwood products indicated the relative industrial importance of the properties to be studied. The immediate work is concerned with determining the shrinkage and warping characteristics of the various woods; their specific gravity and rate of growth, and their hardness and type of grain—features that can be brought under control through practical measures of selection and segregation according to properties desired by the user. The program includes also investigation of the woodworking qualities of each species on the laboratory's shop machinery. Information to guide forest growing and management in these species is being sought through correlation of the wood properties and structure with crown size of the trees, with soil conditions, and with depth and duration of flooding on the site.

The selective logging of southern hardwoods was studied at two locations in virgin timber in the "first bottom" of the Mississippi River. The investigation was merely an introduction to the work necessary to establish a basis for selective cutting that will favor efficient and permanent operations in such stands, which constitute a highly complex forest type. On the sites selected, some 20 different species of hardwoods were encountered. Preliminary work was also done toward the development of log grades, a matter of high importance in proper cutting and marketing of the stand. A number of air-seasoning test piles of lumber were set up to obtain fuller data on grade yields and returns.

Problems of the small mill cutting southern hardwoods were given particular attention. Operators were assisted in improving standards of production and equipment and in the more uniform grading of their output. Kiln-seasoning investigations were centered on the refractory southern swamp oaks, in which drying defects offer the greatest obstacle to use. The problem was attacked

new lines, with good results. It was found practicable to process and dry each board of these species in 2 weeks to a moisture content as low as 5 percent, with no checking and with less degrade and shrinkage than when seasoned by ordinary methods. The rate of drying is about three times as fast as that accomplished in the best current kiln-drying practice. Other promising discoveries are made. Further work must be done, but the way is open to methods of drying that may release millions of feet of unused hardwoods for satisfactory service.

WOOD IN CONSTRUCTION AND FABRICATION

Lumber for building and manufacturing purposes accounts for half the total lumber cut, and large additional amounts are used for railway ties, poles, piling, and the like. Improvements in wood use for these purposes offer broad and direct benefits to economic forestry, forest markets, and forest land use. The laboratory continued its research on wood as a structural material, looking toward modernization of building practice through the use of composite members and parts and through basic improvements in timber engineering. Arches afford one of the most effective means of carrying loads in a building so as to get large clear floor areas, but in this country its use in wood construction remains undeveloped. Laboratory tests demonstrated the safety of laminated arches, which can readily be made to any curvature, and showed that in most instances stresses resulting from the bending of the laminations to curved form do not appreciably reduce the load-carrying capacity. Further study is concerned with the effect of end joints on the strength of the arch, the possibility of using air-grade material for certain laminations, and methods of simplifying design.

The increasing use of plywood for engineering and construction purposes has created need for data on methods of calculating plywood strength. An approximate method of calculating the bending strength of Douglas fir was developed and supplied to the industry by special request. More accurate formulas for strength, stiffness, and other engineering properties of plywoods are expected from comprehensive studies now under way.

The proper selection of lumber for specific uses has long been handicapped by technicalities and nonuniformity in commercial grading rules. The laboratory took a long step toward remedying the confusion by submitting to the industry a simplified and uniform basis for the development of lumber grades for all commercial softwood species, to meet better the needs of architects, builders, and home owners on a basis of use requirements. A guide was also prepared for the purpose of clarifying American lumber standard provisions for the grading of structural timbers. The revaluation of the shearing strength of large beams which has been accomplished by analysis and test of the effect of seasonal checks was adopted last year in standard specifications for bridge timbers, with large potential economies of material.

There was published a bulletin on the laboratory's investigations of the bearing strength of bolted wood joints, which amounts to a practically complete revision of engineering data on this critical design factor. Another bulletin, presenting the results of tests made in cooperation with the National Committee on Wood Utilization on a variety of modern metal connectors, made available working data which point the way to increased efficiency of construction, simplified shop fabrication, and rapid erection. A circular on the efficient design of wooden crates was issued. A much larger publication, now practically ready for press, is a handbook of wood construction and use that brings together for the first time the available information in this whole field, from the laboratory and other sources. A handbook dealing in simplified terms with wood construction on the farm is also nearing completion. A report on special studies of the strength and other properties of redwood was published as a bulletin, and a revised summary of the strength of the principal American wood species is in preparation.

PULP AND PAPER

The home market for pulp and paper offers outstanding opportunities for utilizing more American land and labor. More than half our consumption of pulp and paper depends ultimately on imports of foreign pulpwoods and their products. The present challenge is for more efficient, economical, and satisfactory production of pulp and paper from native stands now existing—stands that can be made self-replacing under profitable use.

The laboratory's pulp and paper investigations have contributed to the increasing use of such species as the pines, hemlocks, Douglas fir, and certain hardwoods. Between 1920 and 1930 the percentage of domestic spruce and balsam fir used in pulp production fell from 58 to 36 percent. Last year's work had to do in part with woods such as Douglas fir and the southern pines, which on account of their resinous character are usually regarded as proper material only for the sulphate or kraft process. Experiments with the new soda-base and ammonium-base processes resulted in true sulphite pulps of satisfactory strength and bleaching quality from those abundant woods. A new and promising source of tissue papers, which stand high in tonnage consumption, was found in western hemlock pulped by the standard sulphite process. The finding that finely broken up wood can be satisfactorily pulped if proper circulation of liquors in the digester is provided for has special significance in relation to the possible pulping of vast quantities of sawdust waste.

The utilization of semibleached sulphate pulps to replace unbleached sulphite in newsprint production was successfully applied to Florida sand pine, which shows excellent possibilities as a pulpwood. Strong white papers, newsprint and specialties such as greaseproof and glassine were also made from Monterey pine by the laboratory's sulphate pulping and bleaching process.

Why ordinary sulphate pulping yields a dark product difficult to bleach has hitherto been unknown. A fundamental study now in progress may furnish the solution and also furnish important results for practical application. Investigation of the several possible sources of dyestuffs in pine-wood sulphate pulps definitely linked these discoloring materials to the so-called phlobatannins and the condensation or oxidation products, the phlobaphenes. The phlobatannin derivatives are also probably responsible for the reddening of sulphite pulps. Further work on larger amounts of the dyes should establish their exact identity.

CHEMICAL AND PHYSICAL PROPERTIES OF WOOD

Progress in the utilization and conversion of wood is bounded ultimately by our knowledge of the wood as a complex of chemical parts and as an organic structure shaped by varying conditions of growth. Further research in the chemistry of wood gave a broader and somewhat simplified view of its constituents. Considering the total extractive-free wood substance, the new term "holocellulose" was introduced to apply to the whole carbohydrate content covering into one group the stable cellulose and the so-called "hemicelluloses" and other sugarlike bodies related to it. The remaining substance is designated simply as lignin. This is not merely a revision of terminology. Means of separating wood into these two distinct divisions were developed so as to account for all the material with little or no degradation. Clues obtained in the work point toward a possible new means of delignification of wood that may give higher yields of useful pulp than are now common.

The isolation of lignin in apparently pure form by the use of sulphuric acid at low temperatures measurably simplifies the problem of its composition. In hardwood lignins at least three different kinds of hydroxyl groups were found. Acetate groups, the source of acetic acid, were shown to exist only in the holocellulose. Methoxyl groups were found to lie chiefly in the lignin, but not entirely in the lignin as formerly supposed. In hardwoods an important portion, amounting to some 26 percent of the total methoxyl, was traced to the holocellulose.

Investigations of the chemistry of extractives threw further light on the properties. Two phenols, in a liquid and a crystalline form, were isolated from western red cedar. The latter was found about equal to mercuric chloride (corrosive sublimate) in toxic effect on test fungi. An attempt will be made to determine its exact composition, which may afford the basis for a new and effective wood preservative. Completion of the study of ether extractives of the southern pines, with particular reference to their influence in pulping processes, added considerable information on both the chemical composition of these materials and their distribution in the tree. Work of the laboratory on the ether extractive of Douglas fir and ponderosa pine and on the water-soluble extractive of redwood proved useful to the termite-investigations committee in their experiments on the relative resistance of the two woods to termite attack. The laboratory's data on the distribution of extractive in redwood are included in the committee's report.

Study of environmental factors as affecting the growth, structure, and properties of wood was continued. Previous findings regarding means of controlling summer-wood production in the southern pines were amplified by a study of spring-wood production. An explanation of the increasing proportion of springwood with increasing height in the trunk is being sought on the basis of the size and activity of the tree crown in the supplying and translocation of food.

bulletin on the causes of brashness in wood and its elimination through selection and growth control was issued, and a report on the occurrence, structure, and properties of compression wood was prepared for publication.

To assist in the determination of forest-fire hazards under varying weather conditions, a new type of "fuel hygrograph" was developed and built in cooperation with the Northern Rocky Mountain Forest and Range Experiment Station. This instrument measures and records wind velocity, duff moisture, and the moisture content of a group of wood samples representative of small tree limbs.

The prolonged drought of 1931-32 in the Southeastern States afforded an excellent opportunity for observing drought effects on oleoresin production in the pines. Microscopic examination of the inner bark or phloem revealed that darkening and pitch soaking were the definite precursors of dry-facing. Continued heavy turpentine after this stage often resulted in the death of trees, but when chipping was stopped or light chipping practiced the trees generally recovered and maintained production. This indication was an incidental finding in the study to connect biological or growth factors with the formation of oleoresin, the raw material of naval stores. The progress made encourages the hope that high-yielding trees can ultimately be distinguished from low yielders in advance of chipping, and that high-yielding strains may be further developed.

RELATED INVESTIGATIONS

The preceding condensed review of leading laboratory projects has passed over much of importance, some of which calls for brief mention.

It should be stated that all the work of the laboratory is greatly benefited by transfer, now complete, to the new, large, and modern building erected for its uses by the Government on a choice site donated by the University of Wisconsin.

Intensive investigations were begun looking to facilitation of an integrated industrial set-up founded on sustained yields of naval stores, lumber, and pulp from the slash-longleaf type of forest. A report on previous studies of logging and milling in the loblolly pine forests of North Carolina was published in bulletin form. A new study of commercial air seasoning of long-leaf pine and further study of the problems involved in lumber storage added to practical knowledge relating to moisture removal and control. Reports on the regional investigation of moisture content of wood in dwellings and on the specific gravity and related properties of commercial softwood lumber were issued as departmental publications. Progress was made in the design and testing of new types of glued laminated joists and dowelled joists. A way was found to decrease the weakening effect of notching joists where they are supported by the girders. Various types of fasteners were studied, the tests being particularly directed toward filling in gaps in the data on nails, screws, and drift pins.

The creosote treatment of southern pine poles, the effects of heating on wet wood, and two chemicals of considerable promise as wood preservatives were studied. One of these chemicals, dichloralphanaphthol, is highly toxic to fungi, odorless and colorless, and is therefore suitable for the treatment of construction timbers on the inside of buildings, wood parts of automobile bodies, and the like. A report of the laboratory's researches on the toxicity of chemicals to living organisms was published as a technical bulletin. Substantial progress was made in the development of new fire-retardant treatments for wood. In continuation of the study of paint behavior, it was found that none of the extractives occurring in American commercial softwoods seriously affect the durability of the coating unless present in large amounts or under exposure to excessive moisture. An investigation of the priming of lumber at mills, a recent commercial development, showed that higher grades of paint materials than are now used are necessary if any considerable degree of moisture exclusion is to be obtained by a single application.

In the sulphate pulping of Douglas fir and the soda pulping of loblolly pine the effect of two different ratios of chemical to wood was studied. A new study of ground-wood pulping variables was undertaken. The work thus far indicates that fiber length of the pulp increases with the temperature, the resultant effect in quality being noted principally in an increase in tearing strength. An increase in the temperature also appears to cause a decrease in power consumption and an increase in production rate. Other useful accomplishments in pulp and paper research were determinations as to the colloidal nature of the "hydration" and fiber characteristics of beaten pulp, an evaluation of starch gum as a sizing material, detailed improvements in methods and apparatus for the evaluation of fibers and papers, and the further development of control apparatus for stuff preparation and papermaking processes.

RANGE RESEARCH

The value of range research has been strikingly shown during the past year. It aims to determine how to produce and utilize forage on range lands most effectively. Those stockmen who have followed the essential principles developed have withstood the depression with its low prices much better than has the average stockman. Range-research results have furnished the foundation for the range phases of the emergency conservation work. In the artificial reseeded, for example, which will restore vegetation for grazing and for erosion control on many thousands of acres, the plants which have been proved promising in the several hundred research tests will be sown on a broad scale, while unwise seeding with plants which have been proved to be unadapted to western-range conditions will be prevented. Likewise, the greatly expanded program of eradicating poisonous plants from the range by this corps will follow approved methods of eradication. Many other valuable results might be cited.

An exhaustive analysis made for the Copeland report brought out clearly the problems involved in the conservation and use of the forage resource on the 33 million acres of forest land grazed. They are evidenced by the poor condition of much of the forest-range area of the West, the extreme and continuing deterioration of forage and watershed-protective values on most public-domain forest lands and on a considerable part of the private forest lands in the West that are grazed, the damage to timber production in the South resulting from uncontrolled burning of forest lands in an effort to improve range conditions, and the deterioration of some farm woodlands as a result of heavy browsing of tree sprouts. These problems emphasize the need for considerable expansion of the range research program.

Although hampered by reduced appropriations and a heavy load of planning and handling emergency work, good progress was made on going research projects. The value of conservative grazing in stabilizing production of cattle in the northern Great Plains area in Montana is indicated by recent studies there. Under the common range practice of the area, vegetation is so closely utilized each year that there is no reserve to offset scant production during drought, such as prevailed for 3 years up to the spring of 1932. Inadequate feed culminated in forced shipments of nearly 60 percent of the breeding herds in the area, at ruinous prices. Contrasted to this, on experimental ranges conservatively grazed, the breeding herds were fully maintained, although supplemental feeding was necessary. After the break of the drought, forage production on the experimental ranges was from 2 to 3 times as much as on outside ranges, and of far better quality. Young cows gained nearly 3 pounds per day until well into the summer of 1932.

Another result brought out in the study is that at least 30 acres of this type of range in reasonably good condition are required to support a cow through the year. Three-year-old cows with ample range forage weighed in early June, on an average, 43.9 pounds more than those that had been on heavily grazed range the previous 11 months, and their month-old calves averaged 6.7 pounds heavier. At 5 cents a pound these increased weights more than paid for the additional range used. Further, the overgrazed ranges declined in value.

Studies completed during the past winter of range conditions on the foothill and desert range of the Intermountain region clearly indicate why social and economic conditions are so unsatisfactory for the part of the industry using these ranges. In the sage brush-wheatgrass foothills, grazing capacity on most of the land has declined almost 70 percent as compared to check areas largely protected from grazing and now in good condition. Much of this decline has been in palatable grasses. In the desert-shrub types that are used for winter grazing the decline in grazing capacity has reached an average of 58 percent. White sage, which is an excellent forage, has been replaced over extensive areas by other brush and by weed species of low forage value. Less intensive check of conditions in the winter range of eastern Utah, in the Snake River Plains of southern Idaho, and in northern and central Nevada show declines in grazing capacity of from 50 to 80 percent. The greater part of these declines have occurred in palatable perennial grasses, which have been replaced by annual plants and weeds, both of much lower value than the grasses.

Further analysis of the influences of climate and grazing upon black gram grass ranges in southern New Mexico indicate that it is possible to predict, from the rainfall of 1 year, whether in the following year there will be a greater stand available, or less. If the rainfall is above the normal, the stand of black gram will increase in the following year, and if it is below normal will decrease, regardless of the following summer's rainfall. The rainfall of each summer, however,

largely determines the height growth of black grama on the existing stand. These findings are of great importance in planning stocking and sales of livestock to offset the influence of drought—the arch enemy of profitable livestock production on semidesert ranges of the Southwest.

EXPENDITURES AND RECEIPTS

The expenditures during the fiscal year were as follows:

General administration.....		\$263, 040. 68
Administration, protection, improvement, reforestation, and extension of national forests:		
Operating expenditures—		
Timber use.....	\$457, 317. 77	
Grazing use.....	781, 039. 85	
Recreation and land use.....	283, 104. 35	
Fish and game protection.....	135, 266. 27	
Classification, settlement, and claims.....	73, 644. 81	
Maintenance of truck and horse trails.....	1, 152, 258. 84	
Maintenance of other improvements.....	598, 806. 38	
Subtotal.....		\$3, 481, 438. 27
Protection expenditures—		
Fire prevention and detection.....	1, 554, 934. 47	
Fire suppression.....	1, 016, 206. 80	
Class total (fire).....	2, 571, 141. 27	
Protection against insects and tree diseases.....	376, 662. 88	
Subtotal.....		2, 947, 804. 15
Investment expenditures—		
Construction of truck and horse trails.....	4, 594, 113. 31	
Construction of public camp ground improvements.....	75, 000. 00	
Construction of other improvements.....	1, 924, 242. 20	
Equipment and stores.....	2, 005, 218. 03	
Timber surveys and plans.....	156, 885. 70	
Grazing surveys and plans.....	66, 733. 46	
Fish and game surveys and plans.....	16, 206. 98	
Recreational use surveys and plans.....	28, 053. 45	
General surveys and maps.....	162, 736. 66	
Timber stand improvement.....	32, 734. 54	
Reforestation of denuded areas.....	170, 558. 00	
Nurseries and planting stock.....	67, 469. 19	
Acquisition of land, by direct purchase.....	209, 171. 15	
Acquisition of land, by exchange.....	183, 065. 77	
Subtotal.....		9, 592, 188. 44
General planning and direction of emergency conservation work, national forest camps.....		417, 109. 18
Construction and maintenance of forest highways:		
Construction of forest highways.....	\$9, 569, 816. 66	
Maintenance of forest highways.....	407, 357. 71	
Subtotal.....		9, 977, 174. 37
Total, national forests.....		26, 415, 714. 41
Research—		
Forest management.....	571, 552. 84	
Range investigations.....	128, 976. 97	
Forest products.....	643, 035. 12	
Forest survey.....	181, 474. 68	
Forest economics.....	74, 056. 85	
Erosion and streamflow.....	96, 235. 64	
Forest taxation and insurance.....	39, 935. 65	
General planning and direction of emergency conservation work.....	6, 846. 13	
Forest Products Laboratory, construction.....	233, 565. 96	
Total.....		1, 975, 679. 84
Protection and reforestation of other than national forest lands:		
Tree planting in cooperation with States.....	73, 780. 13	
Fire protection in cooperation with States.....	1, 865, 895. 00	
Protection of Oregon and California grant lands.....	90, 611. 36	
Extension of forestry practice on State and private lands.....	122, 023. 83	
Total.....		2, 152, 310. 32
General planning and direction of emergency conservation work on State, private, and erosion and flood control camps.....		93, 706. 31
Miscellaneous—		
Examination and administration of power sites for Federal Power Commission.....		18, 619. 00
Grand total.....		30, 919, 070. 56

In addition to the expenditure for acquisition of land by exchange, national forest timber having an estimated value of \$238,868 was cut under agreements involving the acquisition of land and timber through exchange. The cash expenditures recorded opposite "Acquisition of land, by exchange" cover merely the outlay incidental to examining lands offered for exchange and appraising the value involved.

The following statement shows the gross and net cash receipts from the national forests:

Gross receipts:	
From the use of timber.....	\$782,808.33
From the use of forage.....	1,498,208.82
From special land uses, water power, and miscellaneous receipts.....	345,031.99
Total.....	\$2,626,049.
Amounts paid to States:	
To Arizona and New Mexico (account school lands administered by the Forest Service).....	28,456.35
To States in which national forests are located (act of May 23, 1908).....	650,860.74
Total to States.....	679,317.
Net total receipts to United States Treasury.....	1,946,732.

The total of the gross receipts is greater by \$331,801.81 than that for the previous year. Receipts from timber decreased \$266,299.23, grazing receipts increased \$668,248.70, and miscellaneous receipts decreased \$70,147.66.

In addition to the cash receipts from timber there should be credited the value of the timber cut under specific agreements for effecting land exchange estimated at \$238,868.



AGRICULTURAL REFERENCE DEPARTMENT
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REPORT OF THE FORESTER, 1934

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., September 1, 1934.

SIR: I transmit herewith the report of the Forest Service for the fiscal year ended June 30, 1934.

Respectfully,

F. A. SILCOX, *Forester.*

HON. HENRY A. WALLACE,
Secretary of Agriculture.

A HUGE WORK RESERVOIR

One-third the area of the continental United States is forest or potential forest land. Sound economics requires that this area be so managed that it may permanently support its fair share of the Nation's population. The fundamental purpose of public conservation policies is to solve this problem. To accomplish it, lands must be kept productive and forest resources managed as crops, on sustained-yield bases, rather than as mines. This is a long-time job; one that calls for national planning and involves the problem of privately owned lands. For nearly three-fourths of our forest land is in such ownership. These private lands have furnished 98 percent of our annual cut of forest products and, logged with no regard to the future, a great proportion of them will be in no condition to yield new timber crops for decades.

The task calls for rebuilding much of our forest empire; for improving and developing still more of it. This is both possible and feasible. And once this task is accomplished, forests can support many more people than they now do; forest capital will be secure rather than insecure; forest industries stable instead of unstable; permanence rather than enforced migrations may characterize the lives of families; whole communities can then depend upon a continuous supply of forest products.

In this rebuilding and improving lies an unparalleled opportunity. By means of such work, forest properties will become added sources of labor employment and of supplies; the doing of it will aid in the immediate national fight for relief; social and economic reconstruction and rehabilitation will be forwarded. From this huge work reservoir, old jobs may be replaced by new.

In this respect, past performances are indicative of future possibilities. During normal times, forest work gave full-time employment to approximately 500,000 people. The sale and distribution of forest products helped keep another half million or more in jobs. Two and a half million farmers secured sorely needed supplemental cash incomes, plus wood and building material, from forest lands. The predepression capital value of our forests and forest industries has been estimated at 10 billion dollars; gross annual income from forest-industry products averaged close to 2 billion dollars prior to 1929. And though they include only some 162 million acres of land, the Federally owned national forests furnished more than 26,000,000 man-days of work during a 4-month period in 1933-34.

This work is essentially an investment. Planned to help protect, develop, and perpetuate forest resources, it has made Federal forest properties more valuable. Facilities for fire protection have been bettered, timber stands

improved, recreational resources expanded, old burns replanted, and erosion checked. All these things are in the public interest. They work toward a coordinated development of forest resources and facilities, present and future. They contribute to the good of the entire Nation; constitute investments which may be relied upon to produce dividends with wide social as well as economic values.

Ever since the close of our pioneering period, forest industries have created local markets for farm products, provided full- or part-time work for farm populations, and helped lighten the burden of taxes. Forest recreation and wildlife have afforded sources of income. And the indirect values of forests in helping to prevent losses have been enormous.

It is recognized, for example, that the destruction of forest cover contributes to floods, erosion, and silting; that the presence of forest cover helps to retard run-off and control erosion and silting. Yet we still have more than 41,000,000 acres of privately owned forest land burned annually; more than 74,000,000 acres devastated or sparsely stocked with young growth; more than 380,000,000 acres on which private owners have failed to install such management as will keep the lands producing forests. In the face of such conditions we have continued to repair the results of national catastrophes with little regard to forest influences. Flood damage in a southern State once noted for its virgin forests has averaged close to a million dollars a year for 20 years; flood damage in a nearby State is about the same. The national bill for removing silt and other river and harbor work designed to aid or restore navigation has already exceeded 2 billion dollars. And there are, right now, some 2,000,000 acres of old burns on the national forests. They represent in large part man's carelessness with fire; reforested, they again become productive.

These facts illustrate some of the indirect values at stake. They point to national responsibilities. They indicate the kind and the extent of projects which offer opportunities for noncompetitive work in maintaining, restoring, improving, and perpetuating our forest resources and so providing permanence for family and community life. This can be done without glutting the market for there are many uses in addition to industrial for growing forests.

In the past, little labor has been employed in work of this kind. Four-fifths of our remaining forest and potential forest land is, as has been said, in private ownership; and from that land has come 98 percent of our annual cut of forest products. The lumber industry was founded and financed on the basis of rapid liquidation. It supplies forest products by utilizing what nature in its bounty, has provided. Its policy has been to remove timber rapidly; to cut out and get out without thought of the future of denuded lands; with no sense of responsibility for ghost towns in North or South, East or West; without regard to scattered, depressed agriculture and undermined economic and social structure. In this process one after another of the great timber regions have been tapped, then drained, like a succession of huge reservoirs. The last of those reservoirs is now the virgin forests of the far West. They still contain enough timber to last for many years. But the cream has been skimmed. In the meantime centers of population, with the bulk of the demand for forest products, are in the East and the Middle West; higher transportation costs are upon us; and prices of lumber and forest products continue to advance as logging operations are pushed into lower grade and more inaccessible forest stands.

In recent years labor and capital have increased production from agricultural lands. They have, at the same time, drained forest lands in private ownership to the point where rebuilding, improving, and developing them is essential to national welfare. There is also an urgent problem in protecting, improving and developing the publicly owned national forests. They contain less than one-sixth of the total forest land in the continental United States. Yet carefully considered plans indicate the need for at least 20,000,000 man-days of work annually, for years to come, on these Federally managed properties. This is significant. For the need is far greater, proportionately, on forest lands now in private ownership. All forest lands unquestionably constitute a reservoir of noncompetitive work which can go far in helping to solve immediate problems of relief, reconstruction, and rehabilitation. Such work is, moreover, essential if one-third of our total land area is not to be handled on a suicidal basis; is, rather, ultimately to support its fair share of the Nation's population.

THE PROBLEM OF PRIVATE LANDS

Of all our forest and potential forest land, that now in private ownership is the most important. It constitutes the larger proportion of the total. It is the bulk of the most highly productive, the most accessible, the most easily logged forest land in the country. It is, too, that which has suffered most. For of the 83 million acres now devastated or poorly stocked, nine-tenths is privately owned; an appreciable part of the remainder reached this condition before coming into public ownership. And 98 percent of the forest area burned annually, during the last few years, has been in private ownership.

This ownership is, moreover, unstable. About 25 million acres of forest land, largely industrial, is now tax-delinquent in the Lake, southern, and Pacific coast regions. With the urge for rapid liquidation, most of it has passed out of production. To avoid carrying charges, it has passed from the tax rolls. This process has been hastened by the depression. Decades are required to grow forest crops. Continuity of policy requires long-time national planning. Stability of land ownership is, therefore, a prerequisite to adequate forest-land management. And unstable private ownership vitally limits the application of that management.

Recognizing this fact, the Forest Service recommended last year an acquisition program involving both Federal and State participation. It placed at 24 million acres the area desirable for acquisition by public agencies within a suggested period of 20 years. This is in addition to areas now so owned and managed. One purpose was to provide necessary stabilization. In that recommendation the Department concurred; to it, hearty support was given. As a result, the Federal policy of land acquisition for national forests has been speeded up. During the last fiscal year 4,206,560 acres of privately owned forest land were acquired or placed under contract of sale to the Government, as against 672,425 acres in the previous year and a maximum of 547,925 in any one earlier year. Accelerated progress is being continued in the current year. The net result of the immediate program will be the addition to the national forests, largely in the eastern, southern, and Lake States regions, of more than 7 million acres of forest, future forest, and watershed-protection lands. They will provide proportionately enlarged opportunities for employment, reconstruction, and rehabilitation; a sound basis for reestablishing permanent communities supported by stable forest industries.

LAND-USE PLANNING

The need for continuing this program at an adequate rate is obvious. Since its accomplishment depends partly on the willingness of the States to participate, an understanding with each State as to the character, amount, and location of the land for which public ownership is necessary or desirable, and as to how the task involved should be apportioned, is being sought. This and other information will be made available to the Department for the National Resources Board and the land policy section of the Division of Program Planning of the Agricultural Adjustment Administration. Through those agencies it may be correlated with data relating to land and water use throughout the country. This study will thus include the whole problem of forest-land use, and the private, State, and Federal forest-ownership program necessary to carry out a national land-use plan.

EMERGENCY WORK-RELIEF PROGRAMS

A requisite in forest upbuilding is protection. Without it, timber cannot be grown nor can other forest resources and services adequately be realized. Protection is, therefore, an investment; as essential for forest as for city property. City fire protection requires more than fire fighters. This is equally true of forest-fire protection. For it, there must be look-out towers from which fires may quickly be discovered; telephone lines over which reports may be flashed; roads and trails over which fire fighters may be transported. Men, plus things like these, constitute the forest-protection system. In the establishment of that system remarkable strides have been made possible through various emergency-relief allotments.

Because of the opportunities in noncompetitive forest work, there was entrusted to the Forest Service during the fiscal year 1934 the planning and

supervision of constructive projects which may roughly be divided into those on (1) national forests, (2) State forests and other State-owned or managed forest lands, (3) State and private forest lands as authorized by the Clarke-McNary Act of June 7, 1924, and (4) private lands on which erosion control work was empowered by the Emergency Conservation Work Act. On the national forests alone more than 26,000,000 man-days of work on planned projects was provided.

The immediate purpose of these activities was largely to relieve distress. They were, however, so planned and executed that they have greatly increased the potentialities of the properties to contribute to the support of the nation's population. Included in the projects were, for instance, (1) improvements of existing timber stands and thinnings and removals; (2) reestablishment of forest cover by the development of tree nurseries and by the planting of reforested areas; (3) diminution of forest destruction by control of insects and diseases; (4) reduction of excessive fire risks by removal of hazardous conditions, construction of forest highways, forest-development roads, protective motor ways, horse trails, look-out houses, telephone lines, firebreaks, and other facilities; (5) reduction or control of soil erosion as a means of flood control; and (6) creation of more favorable conditions for wild animals, birds, and fish.

Results were made possible through the Emergency Conservation Work, the Public Works, the Civil Works, and the Transient Relief programs. Of these, that of the Emergency Conservation Work is, perhaps, the most widely known. It included, during the fiscal year, such outstanding things as the first mass attack ever directed toward the effective control of the white pine blister rust disease; the first extensive direct undertaking in timber-stand improvement; a large increase in forest areas planted; effective work in the control of floods and soil erosion; very substantial progress in the detection, communication, and transportation systems for fire control on national and State forest properties; and progress in the development of forest recreational and forage resources. A detailed statement of E. C. W. undertakings and results is published in the reports of the Director of Emergency Conservation Work. The Forest Service planned and supervised 80 percent of all work projects handled under the E. C. W. program.

Experience in construction work and in recruiting and handling large fire-fighting forces has developed in the regular Forest Service organization the ability to expand quickly and effectively. Quick action in getting National Industrial Recovery Act programs under way in accordance with established standards for similar work was, therefore, possible. With funds provided from the Public Works program, approximately 2,525,000 man-days of employment had been provided by the end of the fiscal year. The maximum number of workers at any one time was 17,475, though this number has been materially increased during the current fiscal year. This does not take into account work which was made possible by an allocation of \$15,000,000 to the Bureau of Public Roads for the construction of forest highways.

Early in December 1933 the Civil Works Administration authorized the Forest Service to employ 31,500 workers on various kinds of national-forest improvement work and on forest and range research. Severe winter weather during the limited period of the Civil Works program prevented as effective handling of the work as was attained with Public Works funds. In many instances the men were undernourished. This necessitated instructions to foremen to favor such cases, pending ability for greater efforts. The Civil Works program did much toward the alleviation of suffering due to adverse economic conditions and provided support to many who otherwise would have been in extreme want. The total number of man-days of work provided was approximately 1,412,000.

The Transient Relief Bureau established work camps on the national forests. Crews, managed by employees of that Bureau, were in many cases quartered in camps not then being used by the Emergency Conservation Work. The large turn-over in enrollment and the emphasis placed on self-subsistence, low costs and relief precluded as high accomplishments per man-day as from other classes of forest workers. Up to June 30, the work was on a very small scale. The numbers engaged fluctuated materially, with an estimated average in the neighborhood of 1,000 men. Subsequently to July 1, additional camps have been established.

THE LUMBER CODE

Under a National Recovery Act code, the lumber industry has committed itself "to conserve forest resources and bring about the sustained production hereof." Industry representatives, in conference with those from the Department and State and other agencies, have established principles to serve as a basis for conservation measures to be required in woods operations. Those principles have received formal approval by the President. Regional rules of minimum woods practice have been accepted by the National Industrial Recovery Agency. They became effective on June 1, 1934. Forest Service representatives have been appointed on Regional Code Authority bodies. The Forester has been named by the President as 1 of 3 nonvoting members of the Code Authority. Recognition is given to the need for audits by a qualified, technical, public agency. The Forest Service has set up its skeleton organization, which provides cooperative inspection of woods operations and technical advice in enforcement of woods-practice rules. In the public interest, as the work progresses this organization must be strengthened.

The purpose of these woods-practice rules, to which the lumber industry has agreed, is to leave forest lands producing. This is a minimum requirement. It is progress over past performances, to be sure. But the fundamental purpose of article X of the lumber code goes farther than this. It aims to assure for each economic unit a continuous supply of forest products; a continuous operation; stability rather than instability of employment; permanence rather than impermanence for communities dependent upon forests and forest products. This is known as sustained-yield forest management. It is essential that it be extended to commercial forests in private ownership. In recognition of that fact, the lumber code permits production control and establishes the principle and practice of cost protection. These two measures help to provide the basis for sustained yield and for forest products at the lowest legitimate possible cost to the consumer. In addition, Federal aid in fire protection is extended to private timberland owners under the Clarke-McNary Act of June 7, 1924; cooperation in research is extended by the Forest Service, and the going value of authorized emergency conservation work on private lands is conservatively estimated to have exceeded \$3 million dollars for the period from April 5, 1933, to and including June 30, 1934.

RESEARCH

Research plays a vital part in all problems having to do with forest lands and their resources. In fact, never before have the demands for varied research in forestry been so great, never before has it been necessary to collect and analyze data so essential to success in a wide range of measures involving social planning and industrial recovery. These demands come from such activities as the conservation article of the lumber code, the emergency conservation work, Tennessee Valley Authority, drought relief, including the shelter-belt project, unemployment relief, Agricultural Adjustment Administration, marketing agreement with naval stores producers, the President's National Resources Board, the science advisory board of the National Research Council, and the Special Cabinet Committee on Rivers and Waterways. In all these, as well as in subsistence farming, submarginal land uses, and many other activities, forest research is deeply involved. The multiplicity and variety of these demands emphasize the need for fluid research funds available to meet special calls outside the regular research program. The regular program itself, vitally important, and needing to be prosecuted uninterruptedly, imposes demands far in excess of the resources provided for it.

THE FOREST SHELTER BELT

The drought of 1934 was unprecedented. The situation was most serious in the Plains area of the Middle West. Within much of this area natural tree growth is lacking; protection against sweeping winds is confined to shelter-belt groves established for the most part by individual ranchers. Isolated and relatively small, these groves offer inadequate protection to the Plains area as a whole. Widespread wind erosion is common. Topsoil is removed, and fertility of farms depleted or ruined. This attrition has been going on for decades. Attention was focussed on it during the current calendar year, when relief for the drought area became a public necessity.

With knowledge of past conditions, President Roosevelt looked to the future as well as the immediate present. Shortly after the close of the fiscal year he signed an Executive order authorizing large-scale shelter-belt planting. He wanted to see permanent, lasting benefits from this, a relief measure for the drought-stricken Middle West. The project represents a progressive experiment by man to ameliorate adverse natural conditions, the full result of which cannot yet definitely be stated. It involves exploration of facts, conditions, and possibilities; collection of technical, social, and economic information.

The shelter belt has been entrusted to the Forest Service. Organization necessary to handle the project in its present stage is on the job. Investigative work is in progress. Plans and methods are being developed for extending the work on such scale as the Congress may determine shall be employed. In the meantime obligations, definite or implied, will not be incurred beyond the \$1,000,000 now available.

ORGANIZATION

During the past year the regular force of the Forest Service has functioned under the stress of an enormous emergency work program. This has been superimposed on regular activities which are heavy in themselves. It has been necessary to expand supervisory, fiscal, and clerical forces many times. Hundreds of inexperienced workers have been trained. Regular personnel and established business methods have absorbed the overload, although the strain has been terrific.

Extension of national forest areas in the East made it advisable to establish effective July 1, another regional office with headquarters at Atlanta, Ga. It has supervision over forests and related functions in the Southeastern States.

A TRIBUTE

My predecessor in office, Robert Young Stuart, met untimely death by accident on October 23, 1933, as he was entering upon the duties of the day. Except for 2 years of military service during the World War and a 7-year period in the service of the State of Pennsylvania as deputy commissioner and commissioner of forestry and as secretary of forests and waters, his entire life work had been with the Forest Service, which he entered in 1906. He had risen through successive promotions to high leadership; in his final position he guided the course of the Forest Service for nearly 5½ years. His sudden death removed from the public service an officer of outstanding ability and of the finest personal character. In this tribute the entire personnel of the Forest Service joins.

LEGISLATION OF THE YEAR

The acts making appropriations were:

The Agricultural Appropriations Act, fiscal year 1935 (48 Stat. 467), approved March 26, 1934.

The act of June 19, 1934 (48 Stat. 1057), carrying the emergency appropriations for 1935. It appropriated \$10,000,000 for forest roads authorized under section 23 of the Federal Highway Act, and also contained an appropriation for agricultural relief under which the "shelter-belt" work of the Forest Service is being done.

The following acts relating to national-forest administration were passed:

The act of June 18, 1934 (48 Stat. 993), authorizing appropriations to provide for emergency construction of highways and related purposes. Section 5 of this act authorized the appropriation of \$10,000,000 for the fiscal year 1936 and \$10,000,000 for the fiscal year 1937 to carry out the provisions of section 23 of the Federal Highway Act.

The act of June 26, 1934 (48 Stat. 1224), which did away with a number of continuing appropriations. This act does not affect continuing appropriations relating to receipts to States, nor the 10 percent of receipts granted the Forest Service for road improvements, nor cooperative funds.

The act of June 14, 1934 (48 Stat. 959), giving the Secretary of Agriculture authority to adjust claims to the so-called "Olmstead" lands in North Carolina, title to which was conveyed to the United States in settlement of a debt.

The act of May 11, 1934 (48 Stat. 773), which restricts the rights of mining claimants within the Mount Hood National Forest by retaining control of the surface of mining locations and claims.

The act of May 26, 1934 (48 Stat. 808), similarly affects lands within the Wasatch National Forest, from which the city of Salt Lake obtains its water supply.

The act of March 10, 1934 (48 Stat. 400), authorizing the establishment of game sanctuaries within national forests.

The act of June 14, 1934 (48 Stat. 955), amending the Weeks Act to permit up to January 1, 1935, under certain conditions, the Governor of a State which has not enacted legislation authorizing Federal land purchases for national forests to give this consent. The act of June 14, 1934 (Private 244), authorizing payment to L. R. Smith for expense incurred in the construction of a road within the Blackfeet National Forest. The act of June 28, 1934 (48 Stat. 1269), authorizing the Secretary of the Interior to regulate grazing on the public domain, although not directly relating to national-forest administration, also requires mention because of its importance in connection with all large administration of Federal lands.

On June 28, the President vetoed Senate bill 3741, to convey certain lands within the Arney National Forest to the State of South Dakota for park purposes, and Senate bill 3092, to confer jurisdiction on the Court of Claims to determine a claim of the heirs of James Taylor, a deceased Cherokee Indian, to lands within the Nantahala National Forest in North Carolina.

The following acts authorizing additions to national forests were passed:

The act of April 14, 1934 (48 Stat. 590), authorizing the President by proclamation to make additions to the Fremont National Forest, Oreg.

The act of April 30, 1934 (48 Stat. 649), authorizing additions to the St. Joe National Forest and extending the Forest Exchange Act. This law will facilitate the establishment by the University of Idaho of a State University forest near Moscow.

The acts of May 3, 1934 (48 Stat. 657 and 658), adding lands to the Pike and Cochetopa National Forests, Colo.; and the acts of May 11, May 17, and May 21, 1934 (48 Stat. 772, 779, and 785), adding lands to the Ochoco National Forest, Oreg., the Boise National Forest, Idaho, and the Mount Hood National Forest, Oreg.

PROGRESS IN STATE FORESTRY LEGISLATION

At a special session of the Maine Legislature a law was passed authorizing Federal land acquisition for national-forest purposes by purchase or gift, but not by condemnation; Iowa passed a law authorizing Federal acquisition by purchase, gift, or condemnation; and in Missouri the maximum which might be acquired in any one county was increased from 25,000 to 100,000 acres, and provision was made regarding the distribution of money received from the sale of State lands to the Government.

Arkansas made the first appropriation for the continued operation and maintenance of the State forestry commission, created by the legislature of 1931, and initially supported by private subscription at the request of the Governor. Virginia revised the make-up of the State commission on conservation and development, effective January 1, 1935, when the present commission of 7 members will be replaced by one of 5, all to be newly appointed by the Governor, with a full-time salaried chairman to be designated by the Governor, and to receive \$6,000 a year.

New York appropriated \$5,000 to provide for the proper celebration in 1935 of the fiftieth anniversary of the establishment of the State forest preserve and the beginning of State conservation activities.

The Maine forest commissioner was designated by law a member of the recently created Baxter State Park Commission. A State planning commission was created by Maryland, with duties that include preparing plans for complete systems of State forest reservations and making surveys of rural-land utilization to determine the areas suitable for reforestation and recreation. Somewhat similarly, Mississippi created a commission consisting of the Governor, the State forester, and the director of the State game and fish commission, to survey all lands owned by the State and determine their adaptability for State forests, forest preserves, parks, or other purposes. The State forestry commission is to cooperate in making these surveys and is to have control and management of all forests and public parks created under this act, with payment of 75 percent of the gross revenue into the State treasury to the credit of the general fund. The South Carolina State Commission of Forestry was given control of all parks belonging to or that may be acquired by the State for general recreational purposes. West Virginia appropriated \$10,000 for the purchase by the conservation commission of lands for State parks.

South Dakota provided for the distribution of forest planting stock to establish windbreaks, shelter belts, forests, and farm wood lots, and to secure the planting of trees upon State, county, municipal, and private lands. The expenses involved are to be met from the State tree fund.

Oregon enacted a new forest fire law, commonly known as the "logging operator's permit law." During the statutory fire period or any extension hereof, on all lands west of the summit of the Cascade Mountains a permit to carry on a woods operation is required. The State forester may close operations whenever in his judgment weather conditions, slash hazards, or

both make operations hazardous; and punishment by fine, imprisonment, or both is provided for operating without a permit or during a closed period. Maine extended by a month the period during which the kindling of fire by nonresidents engaged in camping, fishing, or hunting is prohibited, making the period from May 1 to December 1. Washington provided for the formation, organization, and government of fire-prevention districts outside of incorporated cities and towns, in class A and first-class counties, with a tax not more than 2 mills upon the assessed valuation of the property to meet the cost.

New York authorized the acquisition from the United States, by gift, lease, or purchase, or otherwise, of lands suited for reforestation or other activities permitted by the conservation law, and amended the conservation law in many minor details relating to the assessment and taxation of lands acquired by the State for reforestation.

Arkansas created an "industrial and relief agency" empowered to aid in reforestation, relieve unemployment, and promote the public welfare by securing loans or grants of Federal moneys. Arkansas also provided for the formation of private limited dividend corporations to finance, through loans from Federal agencies or the sale of its securities, or both, and to carry out projects for the protection and development of forests under the supervision of the State forestry commission. Minnesota authorized the State executive council to extend direct relief and employment to the people of the State and undertake projects involving reforestation and afforestation or that will otherwise aid in the conservation and development of the natural resources of the State with payment of the costs from State taxes on intoxicating liquor and beer in force and effect until July 1, 1935.

Illinois and New York enacted laws making provision for reimbursement of the Federal Government for the expense of emergency-conservation work if and when, by a sale of land or products, the State derives a profit from such work.

Oregon memorialized the President, directing attention to the effects of the devastating forest fires of 1933 in northwestern Oregon and urging that, keeping with the spirit of article X of the lumber code and the practice of allocation of lumber production, the production quota for the recently burned area in Oregon be made, to the extent possible, from the entire quota of softwood production in the United States rather than from that of the region containing the fire-killed timber. The purpose sought was to make possible more extensive salvaging operations in this timber than would otherwise be permitted.

WORK OF THE YEAR IN STATE COOPERATION

Federal appropriations for cooperative work with the States during the year as compared with those in 1933 and 1935, are shown in table 1.

TABLE 1.—*Appropriations for State cooperation, 1933–35*

Item	Amount appropriated for fiscal year—		
	1933	1934	1935
For the prevention and suppression of forest fires, and for the forest-taxation inquiry and the insurance study (secs. 1–3 of the Clarke-McNary law).....	¹ \$1,611,580	² \$1,565,635	³ \$1,573,619
For the distribution of forest planting stock to farmers (sec. 4 of the same law).....	79,960	⁴ 56,053	56,119
For farm-forestry extension (sec. 5 of the law, administered by the Office of Cooperative Extension Work).....	69,850	⁵ 50,240	51,319

¹ The item of the appropriation act was \$1,661,580. This was reduced by an administrative cut of \$50,000.

² The item of the appropriation act was \$1,587,513. The initial administrative cut was \$396,878, of which \$375,000 was later restored.

³ Made up as follows: \$1,348,619 from the Agricultural Appropriation Act of Mar. 26, 1934, and \$225,000 from the Deficiency Appropriation Act of June 19, 1934.

⁴ The item of the appropriation act was \$74,736. The administrative cut was \$18,683.

⁵ The item of the appropriation act was \$64,787. The administrative cut was \$14,547.

Table 2 shows in detail the Federal, State, and private funds disbursed by the States or expended under their supervision for the prevention and suppression of forest fires, and the Federal and State funds disbursed by the States for the production and distribution of trees for "windbreaks, shelter belts, and farm wood lots."

TABLE 2.—Cooperative expenditures for fire protection and for the distribution of forest planting stock under the Clarke-McNary Act, fiscal year 1934

State	For fire protection				For the distribution of forest planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Alabama.....	\$33,000.00	\$11,220.34	\$24,085.91	\$68,306.25	\$863.18	\$863.19	\$1,726.37
Arkansas.....	18,000.00	3,978.21	20,810.65	42,788.86	-----	-----	-----
California.....	171,711.00	144,274.07	228,958.49	544,943.56	56.00	56.01	112.01
Colorado.....	-----	-----	-----	-----	1,026.29	3,126.53	4,152.82
Connecticut.....	15,193.00	46,540.91	1,640.64	63,374.55	796.68	796.67	1,593.35
Delaware.....	1,871.00	3,921.31	-----	5,792.31	1,300.00	1,684.55	2,984.55
Florida.....	67,760.00	24,549.65	43,210.35	135,520.00	1,500.00	4,940.25	6,440.25
Georgia.....	41,700.00	13,120.03	28,593.06	83,413.09	1,288.33	1,288.36	2,576.69
Hawaii.....	812.42	1,044.54	-----	1,856.96	1,500.00	5,232.15	6,732.15
Iaho.....	57,218.00	38,206.45	116,391.63	211,816.08	728.00	735.00	1,463.00
Indiana.....	7,126.78	7,126.82	-----	14,253.60	1,500.00	2,667.28	4,167.28
Iowa.....	-----	-----	-----	-----	1,500.00	3,076.50	4,576.50
Kansas.....	-----	-----	-----	-----	829.00	1,379.00	2,208.00
Kentucky.....	5,300.00	6,406.97	-----	11,706.97	1,500.00	3,637.88	5,137.88
Louisiana.....	47,577.00	48,166.65	22,907.71	118,651.36	1,500.00	1,784.84	3,284.84
Maine.....	49,926.00	136,849.07	-----	186,775.07	554.95	554.93	1,109.88
Maryland.....	13,737.00	25,719.06	190.17	39,646.23	910.00	4,898.59	5,808.59
Massachusetts.....	27,925.00	65,329.41	-----	93,254.41	1,500.00	7,143.69	8,643.69
Michigan.....	107,440.00	499,209.19	-----	606,649.19	1,500.00	6,222.37	7,722.37
Mississippi.....	20,716.31	14,027.29	6,752.64	41,496.24	482.00	590.40	1,072.40
Minnesota.....	94,896.00	362,306.65	-----	457,202.65	-----	-----	-----
Montana.....	24,601.00	12,735.44	50,283.27	87,619.71	1,363.64	1,692.54	3,056.18
Nebraska.....	-----	-----	-----	-----	2,500.00	11,320.00	13,820.00
Nevada.....	1,904.00	211.00	4,578.93	6,693.93	-----	-----	-----
New Hampshire.....	15,596.00	31,712.53	4,948.99	52,257.52	1,500.00	3,170.01	4,670.01
New Jersey.....	32,000.00	90,304.50	-----	122,304.50	1,500.00	12,609.29	14,109.29
New Mexico.....	1,955.50	2,762.00	3,200.00	7,917.50	-----	-----	-----
New York.....	82,706.99	237,730.87	-----	320,437.86	1,500.00	3,759.44	5,259.44
North Carolina.....	38,000.00	31,515.27	8,372.75	77,888.02	1,094.02	1,094.03	2,188.05
North Dakota.....	-----	-----	-----	-----	1,500.00	8,120.82	9,620.82
Ohio.....	5,643.00	9,996.00	-----	15,639.00	1,500.00	7,034.41	8,534.41
Oklahoma.....	10,410.13	10,410.18	-----	20,820.31	1,500.00	1,843.47	3,343.47
Oregon.....	82,655.00	134,726.70	140,320.00	357,701.70	1,462.13	1,622.69	3,084.82
Pennsylvania.....	76,671.00	231,133.31	-----	307,804.31	1,500.00	9,299.75	10,799.75
Puerto Rico.....	-----	-----	-----	-----	1,500.00	5,271.50	6,771.50
Rhode Island.....	1,912.00	10,808.24	-----	12,720.24	-----	-----	-----
South Carolina.....	21,604.67	9,144.49	12,689.02	43,438.18	1,400.00	2,502.84	3,902.84
South Dakota.....	791.00	2,175.55	-----	2,966.55	500.00	1,998.23	2,498.23
Tennessee.....	18,300.00	16,915.75	1,493.87	36,709.62	1,500.00	2,242.97	3,742.97
Texas.....	40,530.00	40,046.35	9,153.58	89,729.93	-----	-----	-----
Utah.....	-----	-----	-----	-----	1,000.00	1,675.35	2,675.35
Vermont.....	6,762.00	5,587.34	2,208.96	14,558.30	1,500.00	9,565.59	11,065.59
Virginia.....	31,760.00	24,311.81	12,698.61	68,770.42	1,228.93	1,292.23	2,521.16
Washington.....	79,179.00	71,708.66	73,617.73	224,505.39	1,500.00	2,690.92	4,190.92
West Virginia.....	26,643.00	15,455.54	11,623.77	53,722.31	1,500.00	2,471.12	3,971.12
Wisconsin.....	86,781.00	524,602.86	-----	611,383.86	1,500.00	1,754.38	3,254.38
Wyoming.....	-----	-----	-----	-----	667.96	2,038.75	2,706.71
Federal Administration and inspection.....	66,221.23	-----	-----	66,221.23	1,530.18	-----	1,530.18
Total.....	1,534,536.03	2,965,991.01	828,730.73	5,329,257.77	53,081.29	145,748.52	198,829.81
Forest-taxation and insurance study.....	32,621.44	-----	-----	-----	-----	-----	-----
Unexpended balance.....	20,355.53	-----	-----	-----	21,648.71	-----	-----
Total appropriation.....	1,587,513.00	-----	-----	-----	74,730.00	-----	-----

COOPERATIVE PROTECTION OF STATE AND PRIVATE FOREST LANDS FROM FIRE

Approximately 221,000,000 acres of State and private forest or potential forest land were reported by the States as under some form of organized protection from fire. This was 53 percent of the total of these lands (414,000,000 acres) classed as needing protection.

Table 2 shows a total of \$3,794,722 of State and private funds spent in cooperative forest-fire protection in the fiscal year 1934. The corresponding totals for the fiscal years 1931, 1932, and 1933 were \$5,011,421, \$4,370,274, and \$3,141,445. Thirty-nine States cooperated, as against 38 in the previous fiscal year. Arkansas undertook the work for the first time, under a budget which was made possible largely by contributions from private agencies. Private expenditures for protection provided independently of the organized protective system of course do not appear in table 2; their amount, though undoubtedly substantial in the aggregate, is unknown.

The total area of protected State and private land reported as burned over in the calendar year 1933 was 3,342,690 acres (of which 641,500 acres are classed as not having productive value), as against 3,233,610¹ acres in 1932, and unprotected forest lands 40,166,900 acres, as against 38,410,000 acres in 1932. The 2,701,190 acres of protected productive forest land reported as burned over comprised 1.22 percent of the forest area protected. Of the State and private land burned over in 1933, 92 percent was outside of protected units. The number of fires reported on the protected units was 48,770, as against 55,567¹ in 1932. Of the 1933 number, 22.7 percent were reported as incendiary, as against 28.2 percent in 1932.

The fiscal year 1934 was a period of marked intensification of the protective effort within protected units, rather than of extension of protection to additional areas. This intensification was made possible by the President's Emergency Conservation Work program, which placed Civilian Conservation Corps camps at the disposal of the State agencies wherever the work of the Corps could be an integral part of Federal cooperative projects carried on under existing legislation. The first year's contribution to the cooperative protection of State and private land included the building of 6,878 miles of telephone line, 14,279 miles of firebreaks, and 15,298 miles of roads and trails; the erection of 213 new look-out towers, 53 look-out houses, and many other improvements; the reduction of fire hazards on 380,853 acres; and a substantial amount of roadside and trail clearing. All this made a major permanent contribution to the cooperative protection enterprise.

It was made under agreement with the States that the improvements will be maintained and used. This will mean a substantial increase in the effectiveness of fire-protection effort within the improved areas. It will also mean increased expense to the States in the maintenance and operation of the improvements. It does not mean that smaller funds will be needed in the future for this enterprise. A larger Federal appropriation for this work is a major need of forestry today.

A very substantial stimulus should be given to protection from fire on State and private lands by the adoption of the lumber code, which became effective on June 1, 1934. Under the terms of the code, each operator is specifically held to the prevention and control of fire on operating areas. He is also obligated, where a general fire-protection system is in effect, to correlate his protection system with the general system. Furthermore, where such a system is in effect, or offered, the conservation committee of each code division is to cooperate with public agencies in efforts to bring into the system all forest lands, with each ownership contributing its pro rata share of protective costs. The importance of the opportunities thus presented for extending protection to new areas can hardly be overstressed. It is, of course, yet to be determined to what extent these opportunities will be made use of. The Forest Service and the States may well set up as a primary objective the extension of protection by this means.

COOPERATION WITH STATES IN TREE PLANTING

In the calendar year 1933, 21,970,000 trees distributed by States cooperating under section 4 of the Clarke-McNary law were planted in windbreaks, shelter belts, and farm wood lots by farmers. This was 7 percent less than in 1932.

¹ Figures corrected from last year's report.

The initiation of a cooperative project with South Dakota brought the total of cooperating States to 39, in addition to Puerto Rico and Hawaii. None of the State projects was discontinued, in spite of substantial reductions in State budgets and the fact that it was necessary to reduce the maximum initial allotment to a single State from \$2,000 to \$1,500. The small Federal assistance continued to prove its importance as a stabilizing force. Approximately 22,000 trees were added to forest plantations on farms. The leading States in the number of trees distributed were Pennsylvania, New York, Puerto Rico, Tennessee, Indiana, Georgia, Nebraska, Wisconsin, and New Jersey, each of which distributed more than 700,000 trees.

State forest nurseries played an important part in supplying trees for the erosion-control work of the Civilian Conservation Corps. Of the stock raised as an integral part of the State cooperative projects, 1,330,000 trees were contributed to the corps for planting on national forests. A total free contribution of 1,820,000 trees was made by the States for E. C. W. planting. Of this total, 991,000 trees were planted on municipal forest areas, 8,383,000 on State forest lands, and 16,000 on private land. Beyond this, the facilities of the State nurseries were utilized, with extensive additions, to enable the C. C. C. to grow in them last year approximately 40,000,000 trees for erosion-control planting. The stimulus of Federal cooperation and the assistance which it extended brought about the original establishment of most of the State nurseries, and aided their upbuilding; and but for this stimulus it is highly improbable that means would have been at hand for getting the erosion-control work of the C. C. C. quickly under way on anything like the same scale of operation or with equally successful results in production.

COOPERATION WITH STATES IN FARM FORESTRY EXTENSION

Federal cooperation in farm forestry, authorized under section 5 of the Clarke-McNary law, is conducted as a part of the extension program of the several State agricultural colleges and is administered by the Extension Service of the Department of Agriculture, with the cooperation of the Forest Service.

The purpose of the work is to make known to farmers, through practical demonstrations directed by specialists in farm forestry, where, how, and through the use of what methods they can benefit by growing timber either for sale or for home use and farm betterment. Assistance is rendered toward increasing farm incomes and reducing expenditures through skillful methods of timber production and utilization; toward reclaiming eroding and idle lands through tree planting to check soil wastage and put the unprofitable lands to use; and toward modifying local weather conditions on the farm by establishing protective windbreaks and shelterbelts.

Thirty-three States and two Territories carried on this form of cooperative extension work. Georgia had 3 specialists, New York and Pennsylvania 2, and the others 1 each. Arkansas, Iowa, and Hawaii discontinued their projects. Assistance in forest management was given on 8,953 farms with 898,484 acres of woodland; on 6,514 farms 18,659 acres were planted with small trees for timber production; on 6,517 farms timber was set out for windbreaks; on 349 farms cleanings were made for controlling white pine blister rust; and on 11,632 farms assistance was given along other lines of woodland forestry, including marketing or estimating timber, fire prevention, and maple-sirup or crude-turpentine production.

The 4-H club activities in forestry enrolled 15,489 members—11,553 boys and 3,936 girls. This was a drop of less than 2 percent, following an increase of 48 percent the previous year. Projects were completed by 11,938 members, mostly in timber-stand improvement by thinning, weeding, or pruning, forest planting, tree identification, and timber estimating.

NATIONAL-FOREST ADMINISTRATION

The expenditures for national-forest administration, protection, improvement, reforestation, and extension, totaling \$68,004,335.94, are shown in detail on pages 49 and 50.

The appropriations and allotments of Federal funds for the national-forest enterprise in the fiscal years 1933, 1934, and 1935 are shown in table 3.

TABLE 3.—*Appropriations of Federal funds and allotments from the National Recovery Administration for the national-forest enterprise, 1933-35*

Item	1933	1934		1935		
		Appropriation	Allowed expenditure ¹	Regular appropriation	From N. I. R. A. allotment ²	Total
Appropriations:						
General expenses of administration, protection, and improvement.....	\$7,483,824.00	\$6,896,699.00	\$6,047,321	\$5,876,445	\$450,970	\$6,327,415
Specifically for:						
Fire control.....	1,125,000.00	536,900.00	524,450	100,000	12,487	112,487
Improvements, tree planting, etc.....	1,371,470.00	1,381,814.00	367,652	30,910	350,358	381,260
Land acquisition.....	200,000.00	85,854.00				
Forest development roads and trails (construction and maintenance).....	8,227,302.60	260,343.30	250,000			
Forest highways (construction and maintenance).....	10,905,000.00	4,457,400.00	4,457,400	1,500,000		1,500,000
Allotments from the National Recovery Administration for: ³						
Land acquisition.....		20,000,000.00	20,000,000			
Improvements, tree planting, etc.....		15,982,745.00	14,982,745			
Forest development roads and trails (construction and maintenance).....		10,000,000.00	10,000,000			
Forest highways (construction and maintenance).....		15,000,000.00	15,000,000			

¹Amounts left after applying the restrictions ordered by the Bureau of the Budget under the general economy program.

²The regular Forest Service appropriations requested for 1935 were reduced \$1,000,000 by the Bureau of the Budget in view of the availability of an equal sum set aside for the purpose from the 1934 National Recovery Administration allotment of \$15,982,745 for "Improvements, etc.," shown above. The entire in this column account for \$813,815 of the total \$1,000,000; the balance was assigned to research projects, as shown on p. 37.

³ Available until June 15, 1935.

The second item in the 1934 column of table 3 is greater by \$412,000 than the corresponding sum shown in last year's report. As usual, the nominal amount appropriated in advance for fire-fighting expenditures was supplemented by a deficiency appropriation to replenish other funds drawn upon, making the total the amount shown in table 3.

THE NATIONAL-FOREST PROPERTIES

The gross area of the national forests on June 30, 1934, was 188,037,023 acres of which 25,445,899 acres were in ownership other than that of the United States, making the net area 162,591,124 acres. During the year the gross area increased 1,199,524 acres, the net area 581,979 acres. Eliminations by Presidential proclamation or Executive orders totaled 30,578 acres, and State selections under land-exchange agreements amounted to 711 acres. Additions by Presidential proclamation or Executive orders totaled 737,910 acres; by order under authority of acts of Congress, 433,452 acres; by acquisition of private lands through exchange, 30,653 acres; by purchase of administrative or look-out sites, 181 acres; and by donations of private lands outside of forest boundaries, 23,370 acres. Recomputations of gross area based on better data increase that area by 5,247 acres. Including in the net area 280,683 acres purchased under the Weeks law in units which have not yet been formally established as national forests, the total at the close of the year was 162,871,807 acres.

Table 4 shows the additions and eliminations.

TABLE 4.—National-forest additions and eliminations, fiscal year 1934

National forest	State	Additions	Eliminations
		<i>Acres</i>	<i>Acres</i>
Apache.....	Colorado.....	1 160	
Do.....	do.....	1 160	
Black Hills.....	South Dakota.....	1 520	
Boise.....	Idaho.....	2 257,209	
Burson.....	New Mexico.....	1 2,939	
Chequamegon.....	Wisconsin.....	3 362,660	
Clearwater.....	Idaho.....	4 5,172	
Do.....	do.....	4 88	
Cochetopa.....	Colorado.....	2 164,388	
Dixie.....	Utah.....		3 5,821
Emery.....	Wyoming.....	1 342	
Do.....	South Dakota.....		3 229
Essen.....	California.....	6 160	
Do.....	do.....	6 5	
Fl.....	Montana.....	1 122	
Endocino.....	California.....	6 2	
Do.....	do.....	6 1	
Godoc.....	do.....	6 2	
Go.....	do.....	6 6	
Nicolet.....	Wisconsin.....	3 375,250	
Choco.....	Oregon.....	2 1,808	
Ke.....	Colorado.....	2 9,842	
umas.....	California.....	6 2	
Gue River.....	Oregon.....	1 9,591	
anta Fe.....	New Mexico.....	1 12,983	
asta.....	California.....	6 3	
Noqualmie.....	Washington.....		3 24,739
Do.....	do.....	1 2,756	
Do.....	do.....		6 242
Do.....	do.....		3 240
Joe.....	Idaho.....	4 9,105	
Do.....	do.....	4 9,005	
Do.....	do.....	2 205	
ngass.....	Alaska.....		3 18
enatchee.....	Washington.....	1 160	
Do.....	do.....	1 640	
hitman.....	Oregon.....	1 280	
Total.....		1,225,566	31,289

Private lands acquired through exchange.

Made under acts of Congress.

Made by Presidential proclamation or Executive order.

Made by donation of private lands.

Made through State selections of exchange lands.

By purchase for administrative use.

The major increase in gross area was effected through proclamations formally establishing as national forests the Chequamegon and Nicolet areas in Wisconsin, in which lands are being purchased under the Clarke-McNary law. Next in magnitude were the additions to the Boise Forest in Idaho and the Cochetopa Forest in Colorado, by specific acts of Congress. The major eliminations were 5,821 acres from the Dixie Forest in Utah, by which the Cedar Breaks National Monument was transferred to the National Park Service, and 24,739 acres from the Snoqualmie Forest in Washington, comprising an area almost entirely in private or State ownership. The next largest additions were brought about through exchanges and donations involving lands outside the national-forest boundaries. The remaining adjustments were of minor character.

As a measure of economy the Pend Oreille Forest in Idaho was partitioned between the Coeur d'Alene and Kaniksu Forests; while the Natural Bridge Forest in Virginia was combined with the George Washington Forest. Several interforest adjustments were made by the establishment of new dividing boundaries.

The incompleteness of the national-forest system is increasingly evident. In the Western States several million acres of unreserved and unappropriated public lands apparently are more valuable for timber production than for any other economic or social purpose. Intermingled with them are other lands important as watersheds and integrally related to the national-forest lands from a management standpoint. There are also strips or zones about the for-

ests largely made up of private lands which should be added by donation, exchange, or purchase. In the East no adequate management can be foreseen for a large part of the forest land except under Federal ownership. The true proportions of the situation are being disclosed by the land-planning studies now in progress. Decisive and realistic action is needed in deciding upon the future Federal forest policy and program. If the remaining unreserved and unappropriated public lands chiefly valuable for forest and watershed purposes are to be devoted to these purposes permanently, legislation to that end should be enacted without delay. If the Federal Government is to enlarge its forest-acquisition program, its objectives will be attained most effectively and least expensively by the prompt formulation of a specific long-term program embodying a clear-cut authorization of the essential appropriations.

LAND ACQUISITION THROUGH EXCHANGE

Private ownership of lands within and adjoining the national forests creates many difficult problems of protection, management, and use. The inside State and private lands total more than 25,000,000 acres, of which more than one-half should be managed in common with the public properties. Wherever railroad land grants traverse the forests, every alternate section surveyed before the forest was set aside is alienated. The school land grants passed 2 and in some instances 4 sections out of each township to State ownership upon survey; this preceded withdrawal for national-forest purposes. Added to these large-scale alienations are tens of thousands of tracts patented or entered under the various public-land laws. Immediately surrounding the national forests are both private and State lands that will serve their highest purpose under national-forest administration.

When exchanges of national-forest land for private lands began it was with a view to consolidating both classes of holdings. In time this was broadened to allow the granting of equal values of national-forest stumpage in exchange for private lands. One or both of these courses of action have been authorized in a total of 57 acts of Congress, of which the most recent is the act approved April 30, 1934. Through them notable progress has been made in adjusting private and public ownerships. Under present conditions private owners do not, as a rule, want more land but increasingly prefer to liquidate by exchanging their properties for national-forest stumpage susceptible of early sale or utilization.

Extensive use of national-forest stumpage for exchange purposes, however, has two difficulties. By diminishing the cash receipts from timber sales, it reduces the 25-percent share of all national-forest receipts payable to the counties. A more recent difficulty is to correlate the cut with that allowable under the lumber code. To protect the counties, the Forest Service general has adhered to the rule that the value of the stumpage granted in exchange in any State during any year shall not amount to more than 10 percent of the cash receipts from timber sales in the same State and year. The falling-off in timber-sale receipts during the past several years has correspondingly reduced the acreage of land obtainable through exchange.

If the consolidation of the public properties is to be accomplished on a scale adequate in acreage and in time to the present and prospective requirements of the economic situation, an increase will be necessary in the proportion of immediately salable national-forest stumpage employed to acquire private lands through exchange, or else acquisition will have to be accelerated by extension to the western national forests of the program of cash purchase of forest lands hitherto effective only in the eastern half of the country. A combination of the two methods seems to be the logical solution. Cases have arisen in which established operating companies have lacked funds with which to purchase national-forest stumpage necessary for the continued operation of a mill, but have been willing and eager to convey their privately owned cut-over lands in exchange therefor. If the mill closed, unemployment conditions would be aggravated and real economic distress caused the dependent communities. Where this situation existed, the counties concerned took the initiative in advocating a departure from the 10-percent limitation, holding that the benefits from continued operation of the mill far outweighed the sacrifice of receipts. A wider acceptance of this view may result in considerable stimulation of the land-exchange activity. However, a real attack on the private-land problem will require that the exchange authority be supplemented

by a program of extensive purchases. The magnitude and urgency of the problem call for accelerated action on so large a scale that its financing through some form of bond issue may be advisable.

During the year agreement was reached with the State of Colorado whereby that State will select approximately 70,000 acres from lands now within the National Forest in exchange for an equal area of widely distributed school sections and other State lands. Through this exchange the State will own a compact area of diversified forest land, not far from the State forest school. Marked progress was made in the pending exchange with the State of New Mexico, much of the offered and selected lands having been appraised and the first selection lists filed. In Michigan a new application of the Weeks law was worked out when the National Forest Reservation Commission approved a proposal of the State conservation department that the Federal Government, instead of buying State lands within national forests, should purchase private lands of equal value within State forests and exchange them for the State holdings in the national forests. In this way practically as much forest acreage will be placed under public management.

Between January 1, 1933, and June 30, 1934, reconveyances to the United States of 155,946 acres of private lands in exchange for 19,763 acres of national-forest land and 108,318,000 board feet of national-forest stumpage, valued at \$61,974, increased the net national-forest area by 136,183 acres. In this same period a total of 155 exchange cases was approved by the Secretary of Agriculture and referred to the Secretary of the Interior for further action. They covered 303,969 acres of privately owned land in exchange for 110,559 acres of national-forest land and \$468,678 worth of stumpage. In all, to June 30, 1934, 1,036 land-exchange cases have been consummated. Through them the United States has acquired 1,555,407 acres of land, valued at \$5,930,023, in exchange for 452,389 acres of national-forest land, valued at \$2,063,776, and 1,095,455,000 board feet of national-forest stumpage, valued at \$3,052,088. Besides a net gain of 1,103,018 acres in national-forest area, the acquired lands support a much larger volume of stumpage than that granted in exchange for them, while Federal management of the acquired lands eliminates many previous difficulties of protection, administration, and utilization.

LAND ACQUISITION THROUGH PURCHASE

The progress made last year in forest-land acquisition under the Weeks and Clarke-McNary laws approached the total of the entire preceding 22 years. This was due to an allotment by the President of \$20,000,000 from the funds made available by the Emergency Conservation Act of March 31, 1933. Approval of 28 new purchase units increased the number from 41 to 69, situated in 23 of the States east of the Great Plains and in Puerto Rico. Substantial enlargements of a number of previously established units also were authorized, raising the gross area of the approved purchase units from 16,589,387 acres to 31,399,662 acres. The 4,206,560 acres approved for purchase during the year brought the total approved to 9,588,884 acres. Including 2,227,395 acres reserved from the public domain and 252,418 acres acquired through exchanges, the United States now owns or is in process of acquiring 12,068,697 acres of and within the national forests in the eastern half of the United States. This is slightly less than one-half of the area within the established purchase units that should be federally owned to make their purpose and service fully effective.

Each new unit or large addition was designed to meet some clear requirement of public interest and welfare. One embraces an additional section of the Green Mountain Range, in Vermont. Another, in West Virginia, includes critical sections of the Ohio River drainage. A new unit in Virginia and several large additions in North Carolina, Tennessee, and Georgia are designed to protect the upper headwaters of the Tennessee River and the important engineering works now in progress on that drainage. An extension of the lumberland unit in Kentucky embraces land important both as forest and as watershed. Two units in North Carolina and two in South Carolina include critical parts of the piedmont region, while another in North Carolina embraces an important segment of the coastal pine-forest types. A new unit in Florida assures constructive management of an important forest area in that State. In Mississippi five new units were created, partly to promote forest conservation, but in a large measure to facilitate control of critical erosion problems.

A large addition in Louisiana is exceptionally important both for timber production and for watershed protection. Four units were established in Texas largely in aid of forest conservation, and six in Missouri, all on important watersheds, but important also for their potentialities of timber production and consequent contributions to better economic conditions. Two new areas were created in southern Illinois, one on the drainage of the Ohio River, the other directly tributary to the Mississippi. A new unit was created in the lower peninsula of Michigan, and large additions were made to the three existing units in the Upper Peninsula. In Wisconsin the existing units were greatly extended, and in Minnesota a new unit was created. Approval of two purchase units in Puerto Rico will contribute to the development of a new land economy in that island. Consideration was given tentatively to establishing a purchase area in the California redwood region, since the national forests now contain no adequate examples of the redwood-forest type, but thus far no area finally has been selected and approved.

A number of States in which Federal acquisition of forest lands hitherto has been unauthorized or restricted are exhibiting keen interest in obtaining the establishment of new national-forest units within their borders. Iowa passed the act of consent required under the provisions of the Weeks law, and similar acts received consideration in Indiana and Ohio. Under the provisions of the Bankhead-Hill Act, approved June 14, 1934, the State consent prescribed by the Weeks law can be granted during the remainder of the calendar year by a governor, with the approval of a majority of the members of the legislative body. The Governor of Alabama has granted consent in relation to parts of the State where purchases previously had not been authorized, and examinations of suitable areas are now in progress.

In each instance where the establishment or enlargement of a purchase unit has been followed by offers and acceptances of lands, the objectives which inspired the initial action have been attained in abundant measure. Opportunities have been opened for employing members of the Civilian Conservation Corps in or near their own States instead of transporting them to remote regions, and for employing usefully large numbers of local citizens under the programs of the National Recovery Administration, the Civil Works Administration, and the Federal Emergency Relief Administration. The labor of the men thus removed from relief rolls contributed largely to the permanent betterment of public properties. Disbursements in payment for lands promptly found their way into local circulation through their use in payment of taxes and other debts, or for purchasing goods or hiring labor, or for betterment of plants, or for investment in other enterprises and resources, and thus contributed to the improvement of economic conditions not only locally but widely. At the same time the lands were acquired at prices substantially below those previously prevailing or which hereafter may prevail. The purchases may be ranked as sound public investment most opportunely made, from every standpoint. The net effect of the year's accomplishments equals all reasonable expectations.

During the year title was taken under the Weeks law, as amended by the Clarke-McNary law, to 574,025 acres, at a cost of \$1,310,789.41. Purchases totaling 4,206,560 acres and creating a total obligation of \$10,007,427.43 were approved by the National Forest Reservation Commission. The average price was \$2.38 per acre for the lands approved for purchase, and \$2.35 for the lands actually acquired, as compared with a previous average of \$4.54 for all lands acquired. At the close of the year the total actually vested in Federal ownership was 5,106,724 acres; its total cost, not including overhead, was \$21,890,815.06; and the average price per acre was \$4.29. The distribution of these lands is shown by States in table 5.

TABLE 5.—*Acreage of timberland purchased in the fiscal year 1934 and total purchases to July 1, 1934*

State	Purchased in 1934	Average price per acre 1934	Total purchased up to July 1934	State	Purchased in 1934	Average price per acre 1934	Total purchased up to July 1934
	<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>		<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>
Alabama.....	1,206	4.32	117,539	North Carolina.....	26,308	3.64	438,588
Arkansas.....	25,667	2.24	350,323	Oklahoma.....	1,888	1.57	60,788
Florida.....	12,059	1.69	246,423	Pennsylvania.....	1,409	6.26	372,564
Georgia.....	8,971	2.09	346,490	Puerto Rico.....			
Kentucky.....	189	2.25	189	South Carolina.....	42,035	3.97	89,637
Louisiana.....	13,020	1.66	91,257	Tennessee.....	3,566	4.35	392,339
Maine.....	300	3.13	33,781	Vermont.....			31,381
Michigan.....	85,739	1.76	394,922	Virginia.....	3,640	4.29	610,828
Minnesota.....	97,826	2.38	228,406	West Virginia.....	2,264	5.77	332,380
Mississippi.....	136,722	2.49	138,632	Wisconsin.....	100,773	1.20	318,859
Missouri.....	10,443	2.20	10,443				
New Hampshire.....			500,955	Total.....	574,025	2.38	5,106,724

COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

Early in the year, 5,821 acres comprising the outstanding part of the Cedar Breaks formation were eliminated from the Dixie National Forest to facilitate the establishment of a national monument to be administered by the National Park Service. Later, under the provisions of an Executive order dated June 10, 1933, the 16 national monuments within national forests and also under withdrawal for national-forest purposes were transferred to the jurisdiction of the National Park Service.

The respective fields of the national parks and national forests have always been demarked on the basis of fundamental distinctions in their land-use objectives. National parks comprise land areas which have such outstanding values as scenic wonders or marvels of nature that the preservation of their values is a matter of national concern and requires rigid exclusion of commercial use of the lands and their resources for other purposes. National forests, on the other hand, are administered for multiple use. The basic principle throughout is that uses are to be coordinated under a master plan designed to realize the largest net total of public benefits. Timber production, water conservation, grazing use, recreational use, and other forms of land use must be planned for together. The establishment and maintenance of public camp grounds, local recreational resorts, wayside stopping places to view a distant vista or a picturesque glen or waterfall, and the like, are incidents of national-forest administration. They coordinate with and supplement such things as withholding timber from sale or restricting its cutting on lake shores and close to highways, locating roads with regard for scenic attractiveness and preventing their disfigurement by unsightly structures or conditions, making pasturage available for the horses and pack animals of vacationists, reserving primitive areas from commercial development, and a veritable host of similar matters of administrative concern. National-forest administration is integral, and separate jurisdiction either over limited areas or specific activities, if carried out in any large way, would lead to chaos.

Toward the close of the Seventy-third Congress a bill was introduced for the enlargement of the Grand Teton National Park, Wyo., under which minor parts of the Teton National Forest would have been given a national-park status. The report of the Department of Agriculture acquiesced in the proposed action, but the bill failed to pass.

NORTHERN PACIFIC LAND-GRANT ADJUDICATION

The suit authorized by the act of June 25, 1929, to adjudicate the equities of the Northern Pacific Railway Co. under the Land Grant Act of July 2, 1864, the resolution of May 31, 1870, and other supplementary laws, continued during the year to receive the attention of the court. As most of the activities involved were of a legal nature and handled by the Department of Justice, participation by the Forest Service was limited to the provision of information and evidence as required by the progress of the case.

LAND ACQUISITION THROUGH DONATIONS

Of lands previously donated under the provisions of section 7 of the act of June 7, 1924 (43 Stat. 653), title to 23,370 acres finally was accepted and vested in the United States during the year, with early probability of similar action on the remainder of the offered lands. Notwithstanding the temporary cessation of offers of donation, all circumstances indicate that a great deal of forest land eventually will be conveyed to the United States under the acts above cited.

PURCHASES AND DONATIONS OF LANDS FOR ADMINISTRATIVE PURPOSES

Under the provisions of the acts of March 3, 1925 (43 Stat. 1132), and June 16, 1933 (48 Stat. 195), 52 small tracts of land, involving an expenditure of \$47,500, were purchased for use for administrative purposes. Title papers for the purchase of 16 additional sites were forwarded to the Department of Justice for approval. The Secretary of Agriculture accepted title to 27 tracts of land donated for the same purposes, in accordance with the act of March 3, 1925.

SPECIAL USES

At the close of the fiscal year 37,969 special-use permits were in effect, as against 37,265 for 1933. Of the permits in effect, 17,933 were without charge, while 20,036 were subject to annual rental charges. The special-use receipts for the fiscal year 1934 were \$297,830.75, an increase of \$19,648.40 over the preceding year, possibly due in part to the payment of notes given for the preceding year's fees.

The bill to authorize a maximum area of 80 acres for term permits issued under the act of March 4, 1915, was not acted upon by the Seventy-third Congress. The present limitation of 5 acres is wholly inadequate to permit of the proper types of development and service, so that it is now necessary to issue one or more supplemental permits of a terminable character. Their consequent insecurity of tenure is a serious obstacle to financing developments. The national forests contain many areas suitable for occupancy by summer homes, resorts, etc., without any conflict with the major purposes for which the forests were created and without appreciable difficulties of administration and management. These areas are distinct economic assets to the regions of which they are parts, and their complete development and use not only adds to public enjoyment of the national forests but also increases the tax base and the income to the Federal Treasury and to the counties. Per acre actually occupied, the cash income from the special-use occupancy far surpasses that from any other form of national-forest use. The creation of conditions under which such uses may be expanded and brought up to higher standards would be wholly in the public interest.

CLAIMS AND SETTLEMENT

During the fiscal year reports on applications for homestead patents totaled 60, of which 59 were favorable and 1 unfavorable; while reports on applications for mineral patents numbered 45, of which 33 were favorable and 12 unfavorable. There were comparatively few applications or appeals for the reclassification and listing of national-forest lands under the forest homestead law. The most noteworthy development of the year in relation to claims was the passage by Congress of the acts approved May 11 and 26, 1934, the first relating to part of the Mount Hood National Forest, in Oregon, the second to parts of the Wasatch National Forest, in Utah. While authorizing mineral locations within the described areas, the acts provide for the retention by the United States of rights of control and use of the surface of such locations, thus lessening the tendency to locate mining claims primarily to establish title to valuable lands for purposes other than mining. This principle might well be extended to other national-forest lands.

PROTECTION FROM FIRE

For the national forests the 1933 fire season was, on the whole, much like that of 1932. It was full of dangerous possibilities, but with localized excep-

ons was nearer an average than a bad fire year. But the wide spread of the national forests throughout the country and the complete lack of uniformity in weather conditions over so great an area, with its various regions, make a composite picture of the fire season very misleading. Somewhere each season has highly critical conditions have to be met. The most disastrous forest fire in 2 decades, the Tilamook fire in northwestern Oregon, occurred during 1933. It was outside of the national forests and is mentioned only as an example of the kind of local situation which may develop in any year. Abnormally dangerous fire conditions also prevailed in southern California, where for 13 of the past 17 years the precipitation has been subnormal, and where at best the moisture supply is insufficient to maintain a vigorous fire-resistant forest cover. Of the total area burned on all of the national forests in 1933 practically 50 percent was in this part of California.

Critical conditions developed also in the eastern Montana and central Idaho forests and parts of Wyoming and South Dakota. In the Lake States the 1933 fire season was extremely severe throughout.

One reason why 1933 was a year of only moderate fire danger was the relatively small number of incendiary fires, in sharp contrast with 1932, when many of the worst fires were incendiary. There was a 44-percent decrease in fires of this class. The C. C. C. made available a fire-fighting force already organized and in the forests, and largely reduced the temptation to set fires for the sake of employment. Further, incidental to the maintenance and operation of the E. C. W. camps, a large number of trucks, both Army and Forest Service, were traveling the roads day and night. Each driver was a patrolman in fact, and a deterrent to the incendiarist. Another influence was the volunteer fire-warden organization, which was even more active last year than during the previous season.

The area burned was less than 0.1 percent of the total area within the national-forest boundaries. Only once before in the last 29 years has this record been attained. The total damage to national-forest resources was relatively small.

Aside from the fact that the fire danger was on the whole moderate, there were three chief reasons for the good record. One was the trained efficiency of the permanent organization in all details and phases of fire prevention, preparedness, and suppression. The recent ultracritical seasons had demanded, and vigorous executive management had produced, highly skillful and competently administered protection. A second reason was the increase that has been made during the past several years in the mileage of protection roads and in other protection improvements and equipment. The third reason was the great help afforded by the C. C. C., both in actual fire suppression and as a deterrent of incendiarism. Early in the season great emphasis was placed on adequate training and organization of each corps unit for fire-suppression work. With rare exceptions the men were willing and anxious to go to fires at any time, and they usually carried out instructions better than the crews ordinarily picked up in labor centers. Without the C. C. C. the area burned in California would probably have been more than twice what it actually was, and severe additional losses would unquestionably have been suffered in the Lake States.

Other expected means of improving fire-control performance include improvements in methods of determining and forecasting fire-danger conditions, improved detection technic to discover fires quicker, the location at strategic points of small groups of trained fire fighters ready to attack immediately when fires are reported, and the construction of permanent firebreaks. The most spectacular and one of the most useful of these barriers is the Ponderosa Way in California, which is under construction, with the cooperation of the State and other agencies. It should be a great help in preventing fires from entering the commercial-timber belt in California. Eventually it will be some 1000 miles in length. These and other outlays for preparedness should save much more than their cost in lower suppression expenditures and smaller losses.

Table 6 shows the 1933 fire record, in comparison with that of 1932 and with the 5-year average for 1929-33.

TABLE 6.—Comparison of fires on national forests, calendar years 1933, 1932, and 5-year average, 1929–33

Item	Number of fires			Percentage of total		
	1933	1932	Average 1929–33	1933	1932	Average 1929–33
Class:						
Burns of 0.25 acre or less.....	3, 626	4, 146	4, 241	57. 42	58. 92	56. 00
Burns of between 0.25 and 10 acres.....	1, 777	1, 811	2, 027	28. 14	25. 73	26. 00
Burns of 10 acres and over.....	912	1, 080	1, 263	14. 44	15. 35	16. 00
Total.....	6, 315	7, 037	7, 531	100. 00	100. 00	100. 00
Cause:						
Railroads.....	94	88	162	1. 49	1. 25	2. 00
Lightning.....	2, 307	2, 690	3, 089	36. 53	38. 23	41. 00
Incendiarism.....	708	1, 268	1, 099	11. 21	18. 02	14. 00
Debris burning.....	305	283	324	4. 83	4. 02	4. 00
Lumbering.....	90	49	94	1. 43	. 69	1. 00
Camp fires.....	698	748	771	11. 05	10. 63	10. 00
Smokers.....	1, 809	1, 565	1, 619	28. 65	22. 24	21. 00
Miscellaneous.....	304	346	373	4. 81	4. 92	4. 00
Total.....	6, 315	7, 037	7, 531	100. 00	100. 00	100. 00
Calendar year				Total area of national- forest land burned over	Total dam- age of national- forest land burned over	Total cost of fighting fires, exclu- sive of time of forest offi- cers
1933.....				<i>Acres</i> 132, 147	<i>Acres</i> 324, 758	<i>Dollars</i> 1 935, 3
1932.....				372, 973	568, 349	997, 4
5-year average, 1929–33.....				394, 981	1, 846, 600	2, 075, 5

¹ \$593,532 of this amount were E. C. W. funds.

THE 1934 FIRE SEASON

In severity the 1934 fire season in many sections was probably the worst since organized protection began. The extremity of drought throughout the Lake States and west of the Mississippi is too well known to require comment. In north Idaho, Oregon, Washington, and some other parts of the West June rains were plentiful; but a long period of unprecedented heat and wind, coupled with dry lightning storms, followed. On the whole the season is rated as more difficult than even the catastrophic years of 1910, 1919, 1924, 1926, 1929, and 1933. Had protection not been better organized and better equipped with facilities and available man power than in those years, losses of the same order, if not of even greater magnitude, could hardly have been prevented.

Largely because of the presence of the C. C. C. and the organized P. W. crews engaged in numerous forms of forest-cultural and improvement work the losses were well in hand. The large increase in mileage of roads and trails and in other protection improvements constructed since the beginning of the emergency conservation work also helped enormously. Man power and facilities, however, are merely tools, though indispensable tools, for the protective force to utilize as skillfully as its organization, training, experience and expertness make possible. The results obtained attest the progress that has been made through the years in developing an efficient protective force and system of control.

The area burned on the national forests to August 20 was 310,000 acres, against an average of 174,000 acres during the same period in the 3 previous years. Compared with 1931, the last of the previous "bad" seasons, 72,000 acres less was lost. Of the two, the 1934 season was much the harder to cope with. More than one-third of the area lost was in the northern Rocky

mountain region and in very large part was land that had been swept by fires in previous years. The destruction of standing timber was therefore far less than would normally have resulted; the effect on watershed protection will probably be the most serious consequence.

The cumulative effect of drought has long been apparent in the western national forests. For nearly 15 years the records have shown a rapidly mounting deficiency of precipitation. The resulting shortage of ground waters affects the vegetation, reduces the moisture content of the forest cover as a whole, shrinks the streams and springs, and makes the forests more inflammable during the annual dry season. The extreme drought of 1934 capped a climax. That even under the adverse conditions of an unprecedented season the losses were far less serious than during earlier outstanding "bad" years evidences the strength of the organized system of fire control which has been laboriously built up.

In 1934, 17 Forest Service employees were killed while in fire-suppression work. Their names follow. One was a veteran of the permanent organization, John S. Everitt, supervisor of the Shasta National Forest, in California, who was trapped and burned to death in a fire on the slopes of Mount Shasta. *C. C. workers:* Joseph W. Howard, Leroy McGinnes, Lester L. Johnston, John Bromet, Walter Kolniak, Edward P. Cruse, William Mattison, Russell Blakely, and Robert Jonutz. *Other employees:* James Owens, William H. Gillespie, Will Wiff, Raymond Ledvina, Claud C. Shannon, John S. Everitt, and Walter Glen Thompson.

PROTECTION FROM TREE DISEASES, INSECTS, AND RODENTS

The white pine blister rust continues to be the most serious tree disease threatening the national forests. Its chief immediate menace to these forests is in the West, where in two separate regions extensive bodies of virgin timber containing as their most valuable species superb stands of white pine in great quantity are endangered. Without control, the disease would in all probability not only kill virtually all the mature white pine in these regions within a few years but also eliminate the tree itself as a component of the forest and a source of future supplies of one of our most useful and valuable woods.

White pine blister rust first made its appearance in the East, where it was introduced from Europe early in the present century, on infected nursery stock. It attacks only the five-needled, or "white", pines, of which the three most important species in the United States as commercial timber trees are the northern white pine, found extensively in the Appalachian Mountains, the northeastern States, and the Lake States; the western white pine, found mainly in the heavily forested portions of western Montana, northern Idaho, and eastern Washington; and the sugar pine of California, which reaches northward into southern Oregon. Control is accomplished by eradicating the alternate host-plants of the disease—shrubs of the genus *Ribes*. In the eastern part of the country the fight against the blister rust has been under way for 30 years, but without involving the eastern national forests to any great extent, since most of the lands concerned are privately owned. But the national-forest holdings in the western white pine and sugar pine regions are extensive, and very large money values are at stake.

The western outbreak of the disease entered the country from British Columbia, where it was first introduced directly from Europe in 1910. It has spread southward to the edge of the sugar pine, and eastward into the western white pine stands of the "Inland Empire." So far, its southward movement has not carried it farther than about 50 miles north of the California line; and while the situation there is being watched carefully and control measures are being applied experimentally on a considerable scale, it is not yet certain that the conditions make advisable an immediate launching of extensive operations with a view to conquering the invasion. But in the "Inland Empire" region the disease gives every promise, if not quickly checked, of rapidly eliminating white pine from the forest and wiping out the entire local white pine lumber industry. The methods of control used by the Forest Service are recommended by the Bureau of Entomology and Plant Quarantine, which handles all control work on lands outside the national forests and with which the Forest Service cooperates very closely. It is now estimated that the white pine lands within the

national forests of the "Inland Empire" region that justify control operation because of their high productivity approximate 1,500,000 acres. The Forest Service attempts control only where the values at stake justify the financial investment. The work has been under way since 1930, but not until 1932 were funds available to carry it forward on a comprehensive scale. The C. C. C. and the availability of additional funds from P. W. A. appropriations made possible last year a great enlargement of the work. By June 30 about 500,000 acres had been cleared of gooseberries and currants, the alternate host plants. This means that the initial job is about one-third completed.

As in previous years, bark beetles were responsible for the most serious insect infestations on the national forests. The winter-killing of December 1932 and February 1933 mentioned in last year's report greatly reduced the volume of infested ponderosa and lodgepole pine in Oregon, but it did not end the epidemic. Much of the remaining infestation was concentrated in groups of trees. During the winter of 1933 and the spring of 1934 the most dangerous of these group infestations on the Ochoco and Deschutes National Forests were treated. The work involved felling and peeling 16,500 trees and burning the bark. It is hoped that additional areas on these forests this fall can be treated by the C. C. C. In the vicinity of Sun Pass on the Rogue River National Forest, Oregon, a beetle infestation in lodgepole pine, which had been checked by the freeze but was showing vigorous recovery and threatened the timber stands on the Crater National Park, was controlled in the spring of 1934 by felling and treating 6,500 trees. For several years intensive control has been conducted by the National Park Service and the Forest Service on lands within and adjacent to the park, and with the completion of this project the park is believed to be completely free from beetle infestation.

In northern California the effects of the winter killing were about the same as in Oregon. It was found necessary on the Modoc National Forest to institute control on two areas where the infestation showed a distinct upward trend, and in cooperation with private owners 5,828 ponderosa pine trees were treated. In the late fall of 1933 and the early spring of 1934 a number of control operations were conducted on the Sierra and Stanislaus National Forests, in central California, and approximately 6,000 trees were treated.

In Idaho the control work which has been carried on for several years in the valuable white pine stands of the Coeur d'Alene National Forest was brought to a successful conclusion in the fall of 1933, with the treatment of 890 trees. This area was so free from infestation in the spring of 1934 that the Bureau of Entomology and Plant Quarantine was unable to find enough infested trees for experimental purposes. On the Kootenai National Forest, in Montana where beetle control operations in white pine have been in effect for a number of years, 2,570 trees were treated in the fall of 1933, and it is believed that this very troublesome epidemic has been brought under control.

In the fall of 1933 treatment was again given to the Douglas fir stands along the North Fork of the Shoshone River, Shoshone National Forest, just east of the Yellowstone National Park. The infestation of bark beetles followed an attack by the spruce bud worm, which weakened the stand and made it susceptible to beetle infestation. The beetles have been gradually brought under control, and last fall's project was largely a clean-up job, since the attacks had become very scattered. The area treated contains a number of resorts and summer homes and is traversed by the main road to the Yellowstone Park east entrance.

The lodgepole pine infestation on the Cache, Wasatch, and Ashley National Forests is nearly or quite under control except for three areas on the Provo River which were given treatment last spring by spraying with oil and burning 10,600 trees.

Grubs of the June beetle, favored by the dry summers of the last 5 years have become a real problem in connection with the successful establishment of tree plantations in the Lake States. An intensive study to find some means of control was carried on by the Bureau of Entomology and Plant Quarantine. The grubs, which live in the ground 3 years before emerging as beetles, cut off the small feeder roots and peel the cambium from the larger roots, thus causing the death of the young trees.

Rabbits also have become a source of considerable concern in connection with our Lake States plantations. The snowshoe rabbit varies in population over a 7- to 9-year cycle, becoming exceedingly numerous just at the end of the cycle. When the rabbits are plentiful they do much damage. Last fall and winter, in cooperation with the Bureau of Biological Survey, an intensive control campaign was undertaken with the aid of the C. C. C. The work was largely experimental. It will be necessary to continue the effort until the number of rabbits is reduced through control or through natural agencies.

TIMBER

The upturn in receipts and quantity of timber cut from the national forests, begun in the last quarter of 1933, continued throughout the fiscal year 1934. The cut under timber sales and land exchanges was 674,541,000 board feet, as against 473,910,000 board feet in the fiscal year 1933 and 1,653,265,000 board feet in the peak year of 1930. This 42-percent increase over last year was due to renewed activity in sales made prior to the depression rather than to new business. In view of the condition of the lumber industry, production of lumber from national-forest timber has not been encouraged. A liberal policy has been followed in granting time extensions for the completion of agreements or for the removal of fixed amounts of timber. No offerings of timber for new lumber-manufacturing plants were made.

In reaction to the fixing of minimum prices and the control of production provided by the lumber code, the price of lumber strengthened during the year. There was also a pick-up in the demand for lumber about the middle of the year; but during the last quarter the demand fell off, and cutting quotas were further reduced.

Through the continued work of the Civilian Conservation Corps a large amount of stand improvement was accomplished. Notable instances are areas in the Black Hills and Harney National Forests of South Dakota, where some 100,000 acres of badly crowded and stagnated ponderosa pine stands are being thinned to make possible reasonable rates of growth; on the Chippewa and Superior National Forests, in Minnesota, where valuable Norway and white-pine stands are being thinned; and on the Cherokee, Nantahala, and Pisgah National Forests, in the southern Appalachians, where the removal of old, ineffective, inferior hardwoods, left from private operations before the areas were purchased for national-forest purposes, is releasing young stands of desirable species which otherwise could not produce valuable timber crops. Work of this nature is attempted only where it promises a return on the financial investment. It is hoped the work can be continued so that the forests on the better sites may be kept in a highly productive condition. Much of the wood cut on the cultural operations was removed under free permit by local inhabitants, often otherwise unemployed, for their own use as fuel and fencing material.

The number of small sales (transactions involving \$500 or less) was 16,304, and of large sales (transactions involving more than \$500) 129. Both showed an increase. No sales involving long-term contracts were made. The small sales constitute an increasingly important factor in supplying the wood needs of the local ranch and community citizenry adjacent to the national forests. During the depression, however, small sales have not been confined to meeting purely local needs. Many families visiting the national forests over week-ends combine work and pleasure. Trailers are attached to the family automobile, and a cord or two of wood taken home. People come to the forest for this wood from hundreds of miles away. The charge made for the wood is nominal.

The national-forest timber-sale business for the fiscal year is summarized in tables 7 and 8.

TABLE 7.—Quantity and value of national-forest timber cut under sales, fiscal year 1934

State	Quantity cut			Value		
	Commer- cial sales	Cost sales	Total	Commer- cial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alaska.....	22,648,000		22,648,000	35,373		35,373
Arizona.....	48,792,000	376,000	49,168,000	119,406	378	119,784
Arkansas.....	12,085,000	222,000	12,307,000	126,008	222	126,230
California.....	67,804,000	1,480,000	69,284,000	148,718	999	149,717
Colorado.....	23,667,000	769,000	24,436,000	52,410	703	53,113
Florida.....	2,437,000		2,437,000	9,006		9,006
Georgia.....	380,000		380,000	1,308		1,308
Idaho.....	39,703,000	4,364,000	44,067,000	132,159	3,916	136,075
Louisiana.....	271,000		271,000	119		119
Maine.....	30,000		30,000	64		64
Michigan.....	4,501,000	126,000	4,627,000	8,897	126	9,023
Minnesota.....	3,893,000		3,893,000	5,553		5,553
Mississippi.....	36,000		36,000	145		145
Montana.....	10,066,000	3,754,000	13,820,000	19,192	3,655	22,847
Nevada.....	460,000	227,000	687,000	356	182	538
New Hampshire.....	3,711,000		3,711,000	11,282		11,282
New Mexico.....	10,321,000	736,000	11,057,000	20,946	748	21,694
North Carolina.....	13,985,000		13,985,000	23,955		23,955
Oregon.....	68,004,000	3,303,000	71,307,000	130,980	2,126	133,106
Pennsylvania.....	1,266,000		1,266,000	4,552		4,552
Puerto Rico.....				2		2
South Carolina.....	354,000		354,000	1,153		1,153
South Dakota.....	20,165,000	374,000	20,539,000	39,723	375	40,098
Tennessee.....	1,936,000		1,936,000	5,056		5,056
Utah.....	8,835,000	2,077,000	10,912,000	17,813	2,115	19,928
Vermont.....	551,000		551,000	3,283		3,283
Virginia.....	6,314,000		6,314,000	7,442		7,442
Washington.....	186,730,000	178,000	186,908,000	400,700	140	400,840
West Virginia.....	239,000		239,000	643		643
Wisconsin.....	427,000		427,000	449		449
Wyoming.....	20,178,000	976,000	21,154,000	53,432	935	54,367
Total, 1934.....	579,789,000	18,962,000	598,751,000	1,380,125	16,620	1,396,745
Total, 1933.....	371,682,000	17,816,000	389,498,000	823,156	15,161	838,317

¹ In addition, minor products not convertible into board feet were cut, the value of which was \$25,783 in 1934 and \$18,524 in 1933.

TABLE 8.—Quantity and value of national-forest timber sold, fiscal year 1934

State	Quantity cut			Value		
	Commer- cial sales	Cost sales	Total	Commer- cial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alaska.....	19,176,000		19,176,000	29,514		29,514
Arizona.....	4,659,000	370,000	5,029,000	11,519	390	11,909
Arkansas.....	20,983,000	241,000	21,224,000	217,496	241	217,737
California.....	58,813,000	1,922,000	60,735,000	89,943	1,304	91,247
Colorado.....	47,027,000	724,000	47,751,000	104,859	661	105,520
Florida.....	3,232,000		3,232,000	12,390		12,390
Georgia.....	582,000		582,000	2,033		2,033
Idaho.....	40,555,000	4,728,000	45,283,000	141,470	4,412	145,882
Louisiana.....	271,000		271,000	119		119
Maine.....	112,000		112,000	379		379
Michigan.....	5,576,000	29,000	5,605,000	10,651	29	10,680
Minnesota.....	1,484,000		1,484,000	2,020		2,020
Mississippi.....	245,000		245,000	389		389
Montana.....	18,096,000	4,002,000	22,098,000	44,595	3,904	48,499
Nevada.....	621,000	141,000	762,000	640	112	752
New Hampshire.....	10,953,000		10,953,000	33,334		33,334
New Mexico.....	10,056,000	909,000	10,965,000	20,123	906	21,029
North Carolina.....	25,918,000		25,918,000	35,390		35,390
Oregon.....	25,357,000	3,043,000	28,400,000	51,590	2,118	53,708
Pennsylvania.....	1,572,000		1,572,000	1,638		1,638
Puerto Rico.....				2		2
South Carolina.....	544,000		544,000	1,858		1,858
South Dakota.....	27,561,000	435,000	27,996,000	29,592	434	30,026

TABLE 8.—Quantity and value of national-forest timber sold, fiscal year 1934—Continued

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Tennessee.....	5,313,000		5,313,000	9,901		9,901
Utah.....	5,917,000	2,421,000	8,338,000	11,643	2,500	14,143
Vermont.....	1,545,000		1,545,000	7,963		7,963
Virginia.....	10,065,000		10,065,000	7,921		7,921
Washington.....	60,326,000	208,000	60,534,000	98,099	159	98,258
West Virginia.....	205,000		205,000	420		420
Wisconsin.....	2,073,000		2,073,000	2,470		2,470
Wyoming.....	32,991,000	1,088,000	34,079,000	81,815	1,057	82,872
Total, 1934.....	441,828,000	20,261,000	462,089,000	1,061,686	18,227	¹ 1,079,913
Total, 1933.....	² 338,269,000	² 18,524,000	² 356,793,000	658,115	15,692	¹ 673,807

¹ In addition, minor products not convertible into board feet were sold, valued at \$29,583 in 1934 and \$24,324 (corrected figure) in 1933.

² Corrected figures, varying somewhat from those published in the 1933 report.

PLANTING

During the calendar year 1933, 69,215 acres were planted on the national forests. This was more than two and one-half times the acreage of any previous year and represents the planting of approximately 70,000,000 trees. The increase was made possible by the availability of the C. C. C. and allotments from the P. W. A. appropriation. For planting stock it became necessary to purchase considerable amounts from private nurseries. Steps were taken to increase Forest Service nursery capacity by the enlargement of some of the existing nurseries and the establishment of three new nurseries—one at Manistee, Mich., which has been sown for a production of 25,000,000 trees; one at Manistique, Mich., sown for a production of 18,000,000 trees; and one near Alexandria, La., sown for a production of 10,000,000 trees. The entire production available during the calendar year 1934 from Forest Service nurseries is estimated to be 100,000,000 trees, which will plant approximately 100,000 acres, as against 2,000,000 acres in need of planting. The work can be economically and effectively done only through a carefully planned program. To produce properly conditioned stock requires from 1 to 3 years, and unless planting funds are assured, the stock grown may be wasted. The increase in planting was largely concentrated in the Lake States, where approximately 49,000 acres were covered—36,000 acres more than in 1932.

The area planted on national forests during the calendar year 1933 is shown, by States, in table 9.

TABLE 9.—Planting on national forests, by States, calendar year 1933

State	Area planted	State	Area planted	State	Area planted
	<i>Acres</i>		<i>Acres</i>		<i>Acres</i>
Arkansas.....	1,312.3	Nebraska.....	742.4	Washington.....	3,786.0
California.....	869.8	New Hampshire.....	6.8	West Virginia.....	1,789.6
Colorado.....	1,775.40	North Carolina.....	16.5	Wisconsin.....	15,282.8
Idaho.....	6,301.0	Oklahoma.....	2.0	Wyoming.....	174.5
Michigan.....	23,857.77	Oregon.....	120.0		
Minnesota.....	9,843.0	Pennsylvania.....	2,134.3	Total.....	69,215.17
Montana.....	1,097.0	Virginia.....	104.0		

RANGE

Virtually everywhere in the West the 1933 grazing season was one of subnormal moisture conditions and forage production. On the national-forest ranges there was an average deficiency in both of about 30 percent. In

Montana and northern Idaho forage production was about 20 percent below normal, with a late spring and short growing period and with especially dry conditions east of the Continental Divide. Heavy early winter precipitation, however, afforded relief and lightened winter-feeding costs in this region.

Colorado suffered the third consecutive year of drought, and most of the national forests in Wyoming the fourth or fifth. In southeastern Wyoming and the Black Hills of South Dakota severe grasshopper infestations were added to drought. Plans for emergency treatment of that situation in 1934 were made in cooperation with the Bureau of Entomology, the States, and local settlers. The moisture and forage deficiencies in the central Rocky Mountain region, as in Montana, were most pronounced east of the Continental Divide.

In Arizona and New Mexico spring conditions were generally favorable except for occasional adverse weather in lambing time, which reduced the lamb crop. Calf crops were good. Summer precipitation was light and spotted, followed by a good fall but a less favorable winter.

In the intermountain region, comprising Utah, southern Idaho, Nevada, and part of western Wyoming, a generally good early spring was followed by unfavorable midseason and late-summer conditions. A drought period has persisted in this region for from 5 to 12 years. California had a cold spring, and national-forest moisture conditions for the season were about 70 percent of normal, with areas as low as 50 percent, resulting in about two-thirds the normal volume of forage. The Washington and Oregon national forests have had 7 years of subnormal precipitation. East of the Cascade Mountains the 1933 season after midsummer was especially dry. In December a severe cold spell caused heavy damage to alfalfa fields, but was followed by very beneficial heavy, warm, early winter rains which produced early feed, cheapened hay, and reduced materially winter feed bills.

At the close of the grazing season lambs and cattle were underweight in the intermountain region and in localized sections elsewhere, but as a rule livestock left the ranges in good flesh. Mountain feed in drier seasons usually makes up in part for the reduced quantity by higher value for conditioning the more mature range stock. Nevertheless, the cumulative effect of a succession of drought years upon most of the western national-forest ranges is raising really serious management problems in many places. Arrested improvement or lowered capacity is general. This has focused new attention on capacity in subnormal years, on the importance of herbaceous growth as soil-protective cover, and on the allowances necessary for game and other uses.

The first consideration must be to assure sustained or improved cover and yields. Some downward revisions in grazing-capacity figures have been necessitated, and more may be. Improved management of the ranges in many instances has not been able to offset the effects of the drought. Nevertheless, the ranges generally have been kept in good productive condition. The exceptions are areas that were in bad shape to start with; adverse seasonal conditions tend to show up and aggravate the sore spots.

The policy has been to render all reasonable assistance to a distressed industry by installing control facilities in the form of fences, water developments, and the like and by improving, with the cooperation of the permittees, the management and distribution of livestock on the ranges. These measures have been important offsets to subnormal forage production. But with a consistent demand for summer range on the national forests much in excess of capacity, it is important that their limitations be more definitely recognized both by the public generally and by the present and prospective range permittees.

Emergency-relief activities have drawn heavily on the supervisory time available for range administration. It is gratifying to record that some of the range permittees are assuming more personal field responsibility in matters of progressive range management. To insure the husbandry and improvement of the national-forest pastures is patently in the permanent interest of the dependent livestock permittees themselves.

A still lower cattle market than in 1932 resulted in abnormal hold-overs. Sheep, lamb, and wool prices rose decidedly but without changing much the demand for sheep range. The almost universally open and mild winter of 1933-34 very fortunately reduced wintering expenses for western stockmen

generally, who in 1931-32 had gone through one of the hardest winters ever known and had not fully recovered from its effects.

The modified grazing fee, which is based each year on the average market prices received the previous year for beef cattle and lambs in the 11 Western States, met with general favor and appreciation among national-forest permittees and their creditors. Fees will increase as market prices increase, but a more prosperous industry can and will absorb such increases in good spirit. The regional agricultural credit agencies rendered an exceptionally prompt, businesslike, and important financing service to national-forest permittees and other western stockmen—a service that will not be forgotten.

RANGE USE

Table 10 shows the grazing use made of the national forests in the calendar year 1933.

TABLE 10.—*Grazing permits issued and numbers of stock allowed under pay permit on the national forests, by States, calendar year 1933*

State	Cattle, horses, and swine				Sheep and goats		
	Permits issued	Stock grazed			Permits issued	Stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Arizona.....	1, 011	191, 089	1, 339	115	96	291, 072	-----
Arkansas.....	43	750	-----	51	1	5	-----
California.....	1, 756	138, 717	3, 883	125	358	367, 723	662
Colorado.....	3, 016	280, 096	2, 160	-----	870	945, 954	50
Florida.....	24	764	-----	31	-----	-----	-----
Georgia.....	94	349	3	17	5	23	-----
Idaho.....	2, 787	125, 423	4, 569	-----	962	1, 313, 633	-----
Montana.....	1, 858	126, 140	6, 151	-----	429	585, 598	100
Nebraska.....	31	11, 667	407	-----	-----	-----	-----
Nevada.....	307	51, 878	1, 823	-----	123	307, 820	-----
New Hampshire.....	6	58	2	-----	-----	-----	-----
New Mexico.....	1, 862	91, 747	1, 704	60	288	191, 617	10, 225
North Carolina.....	67	321	5	112	6	47	-----
Oklahoma.....	47	2, 258	-----	-----	-----	-----	-----
Oregon.....	1, 130	83, 159	1, 340	-----	436	612, 336	-----
Pennsylvania.....	2	53	-----	-----	-----	-----	-----
South Carolina.....	38	70	-----	-----	2	-----	8
South Dakota.....	634	29, 704	1, 067	-----	54	30, 661	-----
Tennessee.....	67	447	12	-----	1	15	-----
Texas.....	3, 764	108, 831	3, 251	22	1, 898	738, 776	-----
Virginia.....	97	1, 003	3	-----	9	286	-----
Washington.....	418	13, 972	309	-----	121	144, 974	-----
West Virginia.....	46	455	11	-----	57	1, 425	-----
Wyoming.....	758	107, 587	3, 758	-----	278	618, 956	-----
Total, 1933.....	19, 863	1, 366, 538	31, 797	533	5, 994	6, 150, 921	11, 045
Total, 1932.....	20, 075	1, 361, 160	35, 105	528	6, 157	6, 308, 500	12, 438

In addition to the stock under permits, there were grazed in the six western national-forest regions 61,760 cattle and horses and 8,555 sheep and goats under the regulation authorizing free grazing of not to exceed 10 head of stock used for domestic purposes, or by prospectors, campers, and travelers, or in connection with permitted operations on the national forests.

The total number of permittees fell off 1.4 percent, and the number of sheep allowed to graze under permit 2.5 percent; but the number of cattle was 0.4 percent greater than in 1932. The national-forest States showing the largest reductions in sheep were Colorado, Montana, Oregon, Wyoming, and New Mexico; Idaho recorded an increase. To some extent the sheep reductions were made by the Government, under its regulatory authority, to protect the range. The cuts made for this purpose curtailed by 25,051 the number of sheep grazed under 55 permits. Four permittees were required to reduce their flocks by a total of 2,910 head to make room for other permittees.

Where circumstances warrant, permittees who have a preference status for range use are granted the privilege of nonuse for a limited period without forfeiting their status. Nonuse requests by preference holders were granted

for 73,581 cattle and horses and 373,819 sheep. This nonuse was largely offset by admitting temporary permittees. Sheep nonuse in 1932 totaled 410,902 head, due in large part to the decimation of herds by the hard winter of 1931-32. These losses could not normally be replaced in a single year. Advantage was taken of the reduced numbers to favor some ranges that were showing the effects of cumulative drought.

The 1934 season will close the first 10-year period. A thorough review of the questions of term permits, distribution and protection, and the general operation of the grazing regulations in view of changed conditions and trends will be made before the next period begins, in 1935.

Table 11 shows the number and percentage of stock allowed to graze under term permits in the calendar year 1933.

TABLE 11.—*Livestock allowed under term or 10-year permits on the western national forests, calendar year 1933*

	Stock under term permits		Percentage of total			Stock under term permits		Percentage of total	
	Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats		Cattle and horses	Sheep and goats	Cattle and horses	Sheep and goats
	Number	Number	Percent	Percent		Number	Number	Percent	Percent
Region 1.....	58, 948	245, 354	40	35	Region 5.....	46, 222	106, 448	31	29
Region 2.....	168, 867	645, 587	41	48	Region 6.....	22, 641	327, 208	21	42
Region 3.....	154, 534	265, 890	51	57	Total, 1933.	720, 177	3, 840, 887	40	62
Region 4.....	268, 965	2, 250, 400	77	89	Total, 1932.	719, 552	3, 968, 618	50	63

RANGE MANAGEMENT

Range-management practices have improved from year to year. A number of factors have contributed to the improvement. Closer supervision on the part of permittees is one of them. Mention has already been made of the increased assumption of responsibility by permittees last year under the stress of emergency demands upon the Forest Service supervisory force. Cooperation with permittees in the development and application of improved management methods ranks high among the factors in better range management. Group cooperation is particularly effective. Stockmen on the national forests are organized in 733 livestock associations, 701 of which have entered into formal cooperation with the Forest Service.

Basic to improved range management are intensive surveys of the grazing resource and the use of the data in management plans. During the year 2,402,848 acres were thus surveyed, bringing the aggregate to 62,576,402 acres. Special unit-management plans have been developed for 3,382 of the 4,191 cattle and horse allotments, and for 4,156 of the 4,946 sheep allotments.

Range improvements were greatly extended in consequence of the C. C. C. activities and the N. R. A. allotments. This work did not get fully under way until after June 30, 1933, and is not, therefore, reflected to any important degree in table 12, which shows only the construction completed at that time. To December 31, 1933, the C. C. C. had constructed on national forests 1,888 miles of stock driveways and 697.6 miles of fences, developed 3,240 springs and wells, built 310 stock bridges and 91 corrals, and gone over 36,405 acres to eradicate poison plants, and 2,716,334 acres to control rodents. During the fiscal year 1934 more range improvements were made than could have been looked for in 10 years at the rate at which funds for prosecuting this work have been provided in the past.

Table 12 shows the range-improvement construction of the fiscal year 1933. Data for the fiscal year 1934 are not yet compiled.

TABLE 12.—*Range improvements constructed on national forests, fiscal year 1933*

Region	Fences		Corrals		Driveways		Bridges		Water develop- ment		Miscel- laneous	Total cost
	Miles	Cost	Num- ber	Cost	Miles	Cost	Num- ber	Cost	Num- ber	Cost	Cost	
-----	38	\$10,751	2	\$460	7	\$554	2	\$66	55	\$4,931	\$1,128	\$17,890
-----	91	25,657	3	648	41	2,820	-----	586	46	3,114	3,891	36,716
-----	364	58,335	11	440	-----	-----	1	3,403	35	5,289	4,581	72,048
-----	46	21,230	-----	120	1	35	-----	37	137	21,418	5,688	48,528
-----	28	7,615	6	883	2	911	-----	78	78	12,101	2,665	24,175
-----	48	6,943	12	2,016	28	1,620	2	760	165	10,991	5,694	28,024
Total 1933	615	130,531	34	4,567	79	5,940	5	4,852	516	57,844	23,647	227,381
Total 1932	388	99,353	18	2,160	37	3,190	3	387	567	63,293	24,910	193,293

Range improvements have a very direct bearing upon better management, better protection, and better utilization of the forage resource. Permittees are benefited through lessened management costs, reduced losses, and better breeding control. Range improvements that will provide adequate watering facilities, automatically control the movement and direct the foraging of animals, and reduce and eliminate loss factors, although essentially mechanical in their working, are the prerequisites for well-managed ranges and livestock. They are in many cases necessary before improved adequate management plans can be installed. They are equally important for erosion and water control and the protection of soil values.

The livestock losses on the national forests in the calendar year 1933 are shown in table 13. In computing the 1933 money loss an average value of \$30 per head was assigned the cattle, as against \$40 in 1932. Sheep losses were averaged at \$5 per head for both years. Poisonous plants continue to be the leading specific cause of loss among cattle, and predatory animals among sheep. The control of parasites and infectious and contagious diseases both to livestock and of wild life is greatly aided by the excellent cooperative relations between State and Federal sanitary authorities. Any manifestations of new or unusual diseases are promptly investigated and laboratory determinations made on occasion. These means of control and the generally thrifty condition of animals on national-forest ranges have made the sanitary conditions remarkably good.

TABLE 13.—*Livestock losses, 1933*

CATTLE AND HORSES

Region	Poisonous plants		Predatory animals		Disease		Other		Total	
	Num- ber	Value	Num- ber	Value	Num- ber	Value	Num- ber	Value	Num- ber	Value
-----	317	\$9,510	20	\$600	106	\$3,180	523	\$15,690	966	\$28,980
-----	2,747	82,410	69	2,070	1,338	40,140	1,700	51,000	5,854	175,620
-----	583	17,490	835	25,050	804	24,120	2,820	84,600	5,042	151,260
-----	1,724	51,720	171	5,130	226	6,780	1,422	42,660	3,543	106,290
-----	399	11,970	65	1,950	165	4,950	1,080	32,400	1,709	51,270
-----	164	4,920	19	570	79	2,370	449	13,470	711	21,330
Total, 1933	5,934	178,026	1,179	35,370	2,718	81,540	7,994	239,820	17,825	534,750
Total, 1932	6,112	244,480	1,123	44,920	2,811	112,440	9,193	367,720	19,239	769,560

SHEEP AND GOATS

-----	2,900	\$14,500	6,781	\$33,905	1,038	\$5,190	10,982	\$54,910	21,701	\$108,505
-----	6,218	31,090	11,871	59,355	3,115	15,575	8,401	42,005	29,605	148,025
-----	1,059	5,295	3,825	19,125	937	4,685	2,512	12,560	8,333	41,665
-----	9,825	49,125	32,305	161,525	4,026	20,130	19,792	98,960	65,948	329,740
-----	1,849	9,245	3,956	19,780	442	2,210	6,209	31,045	12,456	62,280
-----	3,842	19,210	7,671	38,355	3,005	15,025	8,585	42,925	23,103	115,515
Total, 1933	25,693	128,465	66,409	332,045	12,563	62,815	56,481	282,405	161,146	805,730
Total, 1932	28,296	141,480	62,574	312,870	14,663	73,315	54,454	272,270	159,987	799,935

RECREATION AND GAME

The national forests offer many of the requisites for outdoor recreation; spaciousness, scenic beauty, favorable climatic conditions, richness of tree growth and other forms of plant life, fish and game, streams and lakes, striking geological formations, and many other natural attractions. An expanding network of roads and trails affords access to this wealth of recreational opportunity. This recreational resource is now a major factor in the economy of hundreds of communities and thousands of separate business enterprises. In a Nation faced with an increase in the leisure time available to its citizens, and with need for providing means of escape from the intensity of urban life and employment in monotonously repetitive occupations, failure fully to realize the recreational potentialities of the national forests would be a social error. In regions where other economic activities rapidly are dwindling, failure to develop those recreational uses would be an economic injustice to the scores of dependent communities. These circumstances create an obligation to recognize recreational use as a major purpose and service of the national forests and to provide suitably for its development.

Under wholly practicable principles of planned use and management, public use of the national forests for recreation is unquestionably compatible with their other purposes and services. Certain adjustments must be made or restrictions imposed in the utilization of timber, forage, water, and land resources, and in recreational uses. These do not entail net sacrifices of public interest or purpose. They are fully compensated by accruing advantages.

In the national forests, recreational use is informal, democratic, and subject only to a minimum of supervision. It is widely diffused throughout the major part of the forest area. Some particular sections of the national forests, it is true, are exceptionally popular and rather heavily used. But in the main, the visiting public extends its occupancy throughout the whole vast extent of the national forests. And aside from brief periods of extreme fire risk when certain areas of exceptional hazard are closed to use, practically the entire system is always open to public use. The millions of people who use the forests come from all parts of the Nation; automobile license tags of a dozen States can be observed on a single public camp ground at one time.

This recreational use embraces every conceivable type of outdoor activity. A single visitor within a single national forest may combine camping, fishing, hunting, berry-picking, botanizing, mountaineering, geological study, hiking, horseback riding, boating, and other pursuits of pleasure or knowledge. The noon-day picknicker may occupy a site not far removed from an artistic and comfortable summer home maintained on national-forest land under permit. Observations of interesting industrial activities, such as logging, grazing, or mining, frequently enhance rather than detract from public interest and enjoyment. In general, the activity is an excellent example of systematic land-use planning based on well-determined priorities and recognized administrative responsibilities.

The primitive areas, of which there are now 68, with an aggregate area of over 10 million acres, are illustrations of the harmonization of recreational use with other major purposes and objectives of national-forest management. Within these areas all of the basic functions of national forests are carried to full fruition, but at the same time the unique inspirational quality created by the absence of roads, communities, industrial developments, and commercial occupancy is safeguarded and preserved for the enjoyment of the visiting public.

The number of visitors to the national forests in the fiscal year 1933 was estimated as 34,672,125, a decline from the calendar year 1932 of more than 1,000,000 persons. The decrease was in the numbers of hotel and resort guests and of motorists who toured or passed through the national forests. The number of summer-home permittees and guests, campers, and picknickers was more than 400,000 greater than in 1932. These are the classes who use the national forests most. Summer-home permittees and guests numbered 552,685; hotel and resort guests, 1,037,096; campers, 2,219,804; picknickers, 4,355,936; motorists, horsemen, hikers, etc., touring primarily to enjoy national-forest scenery, 5,221,622; and motorists passing through national forests en route to distant destinations, 21,284,982. Many of the latter class are attracted to the routes traversing the national forests because of their scenic interest and charm.

With the additional man power made available by the various relief programs, notably the C. C. C., the P. W. A., the C. W. A., and the F. E. R. A., the national-forest public camp-ground system was markedly enlarged and improved. By the close of the year the number of public camp-grounds upon which had been installed at least some of the facilities essential to the protection of public health and property had increased to a total of 2,229. Not only was the number of improved camp grounds increased by 245, but a large number of the previously developed camp grounds were equipped with additional or superior facilities. While these camp grounds add much to the comfort and enjoyment of the national-forest visitors, perhaps their greatest service is to reduce the hazards to public health and property that would prevail if large numbers of persons indiscriminately distributed themselves throughout the forests without adequate facilities for sanitation and control of fire.

Public interest is being increasingly manifested in national-forest wildlife problems. Wildlife is also attracting increased attention as an economic local resource capable of yielding substantial direct and indirect cash returns to isolated settlers, licensed guides, and business enterprises.

There are fully 60,000 miles of fishing streams in the national forests, and many thousand miles more of these streams beyond the forest boundaries. There are also thousands of natural lakes and artificial bodies of water stocked with fish or suitable for fish production. Still more important is the use of the national forests as summer ranges for herbivorous game species.

The major problem with respect to game has to do with adequate winter feed. At least 60 percent of the big-game winter ranges lie outside the forest boundaries, on the public domain and private lands. Many forests have practically no winter ranges. Approximately 12,000,000 acres of the public domain are actual or potential winter game range. Strategic winter ranges within the national forests are being given special consideration as the need arises or is anticipated in given localities. The national-forest summer ranges afford room for several times the present number of big-game animals without curtailment of the domestic livestock. Game must be studied in relation to its year-long requirements and by localities, because each locality presents its own problem.

Domestic stock and wildlife conflicts have been emphasized by individuals and groups especially interested in recreational and game uses of the forests. So far agitation has been directed wholly at sheep grazing. Only 20 percent of the national-forest areas, large portions of which are at high altitudes above the principal range of deer and elk, is used by sheep. Sheep ranges on the national forests are in full administrative control and are generally in good condition, despite reports to the contrary. Forty-two percent of the national-forest area is used by cattle, which occupy more of the game range; 38 percent of the national-forest area, much of it excellent game country, furnishing food and protective cover, is not used by either cattle or sheep. Game also occupies large areas in common with domestic stock. Large areas are in State and Federal game refuges—25,245,600 acres. Other strategic areas, totaling 3,729,600 acres, are especially segregated and protected in the interests of wildlife. The objective in range use is balanced conservation and use of all the resources involved, in the best public interest. Conditions and trends must be carefully and properly appraised. Through correlation and the meeting of minds, it should be possible to develop intelligent and acceptable programs of administration which will accord wildlife its proper place in forest use.

Table 14 shows the estimated number of big-game animals on the national forests at the close of the calendar year 1933, in comparison with the 1932 number. Since 1921 (the first year in which fairly trustworthy data were obtained) the estimates indicate that the number of antelope has increased 504 percent, black and brown bear 26 percent, deer 107 percent, elk 119 percent, moose 121 percent, and mountain goats 102 percent; but grizzly bears show a decrease of 7 percent, and mountain sheep of 12 percent.

TABLE 14.—*Number of big-game animals on national forests, by States, estimated as of Dec. 31, 1933*

State	Antelope	Bear		Deer	Elk	Moose	Mountain goats	Mountain sheep
		Black or brown	Grizzly					
Alabama.....				750				
Alaska.....		6, 200	¹ 4, 500	42, 500	25	520	8, 300	1, 525
Arizona.....	6, 256	627	8	93, 330	4, 120			205
Arkansas.....		8		2, 500				
California.....	1, 730	12, 787		250, 925	152			449
Colorado.....	97	3, 012	6	48, 840	13, 775	1		3, 189
Florida.....		127		3, 905				
Georgia.....		15		400				
Idaho.....	3, 322	5, 063	75	57, 510	9, 742	466	3, 109	1, 691
Louisiana.....				250				
Maine.....		50		300		4		
Michigan.....		225		6, 155	4	4		
Minnesota.....		1, 490		11, 845	24	2, 735		
Mississippi.....				100				
Montana.....	856	5, 758	465	48, 430	20, 230	1, 924	4, 181	1, 742
Nebraska.....				130				
Nevada.....	205			9, 265	45			146
New Hampshire.....		525		3, 390				
New Mexico.....	1, 062	1, 155	9	104, 850	1, 250			104
North Carolina.....		358		6, 305	20			
Oklahoma.....		4		500	325			
Oregon.....	345	6, 240	1	81, 675	13, 230			50
Pennsylvania.....		200		13, 500				
South Carolina.....				775				
South Dakota.....				6, 380	310		12	
Tennessee.....		28		252				
Utah.....	40	568	4	74, 750	3, 215			151
Vermont.....		50		500				
Virginia.....		354		190	50			
Washington.....		8, 335	8	35, 285	9, 265		4, 581	18
West Virginia.....		875		2, 760				
Wisconsin.....		67		7, 900				
Wyoming.....	545	1, 719	145	22, 185	39, 415	2, 430		2, 880
Total, 1933.....	14, 458	55, 840	5, 221	938, 332	115, 197	8, 084	20, 183	12, 150
Total, 1932.....	13, 150	52, 331	5, 164	946, 546	103, 856	7, 854	21, 736	12, 505

¹ Includes Alaska brown bears.

WATER POWER

The effect of the depression on water-power development, noted in previous reports, continued strongly in evidence. The number of new applications to the Federal Power Commission involving the use of national-forest land has fallen off greatly. While construction work is being prosecuted on projects initiated before the slump in the power market, the principal activities of the Forest Service in assisting the Federal Power Commission have been the supervision of operations of permittees and licensees; valuation, accounting, and appraisal work; inspections of the construction and maintenance of dams; and investigations and reports on applications for amendment of permits and licenses.

At the close of the fiscal year, the Forest Service, acting for the Federal Power Commission, was supervising the operation of 379 permittees or licensees under the Federal Water Power Act. This was an increase of 8 over the number the preceding year. During the year the Commission requested the Forest Service to make 42 investigations and reports. The total number of individual reports made by the Forest Service was 48. It also made 1 valuation and appraisal. During the year 23 applications for permit or license involving the use of national-forest land were received. The total applications to the Commission was 33. As in previous years, the number of cases involving forest land decidedly exceeded the number involving land located elsewhere.

Toward the close of the year it was possible to make a good start in the California region on the power inventory and valuation and on the investigation of the power value of land under power withdrawal or classification. This work is being financed from an allotment to the Forest Service by the Public Works board. Within the time and money available to the Forest Service, it will not be possible to complete all the planned work even in California. But much field work will be done and such of the computations, records, reports, valuations for power and other uses, etc., as is not done from the P. W. A. money can be carried on from time to time in later years.

At the close of the year 208 permits issued by the Department of Agriculture (prior to the passage of the Federal Water Power Act) were outstanding. This was 2 less than a year earlier. The number comprised 98 permits and easements for water-power projects, with an average low-flow output estimated as 516,126 horsepower, and 110 for transmission lines only, with a total length of 897.26 miles within the national-forest boundaries. An annual rental is required for 52 of the power projects, with an estimated output of 491,016 horsepower, and for 87 of the transmission lines, with a length of 729.83 miles within the forest boundaries. The 46 power projects under free permits had an estimated average output of 25,110 horsepower, and the 23 transmission lines under free permits had a length of 167.43 miles within the forests.

ROADS AND TRAILS

Table 15 shows the present status of the transportation system planned for the national forests. The forest highways are roads required primarily for public travel, while the forest-development roads and trails are primarily for the protection, administration, development, and utilization of the forests. Tables 16, 17, and 18 show by States the miles constructed and maintained and the expenditures and apportionments of the various road funds; and table 19 shows the condition of these funds at the close of the fiscal year.

TABLE 15.—*Classification of mileage in forest road and trail system and expenditure required to complete the system to a satisfactory standard, June 30, 1934*

Class	Total	Satisfactory standard	Unsatisfactory standard	Non-existing	Expenditure required to complete
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Dollars</i>
Forest highways.....	17,926	7,924	8,743	1,259	156,323,800
Forest development roads.....	86,023	36,532	21,851	27,640	53,279,400
Total.....	103,949	44,456	30,594	28,899	209,603,200
Trails.....	150,788	122,178	13,116	15,494	3,366,200
Total.....					212,969,400

TABLE 16.—Construction, improvement, and maintenance of roads and trails from forest-road appropriations and other Federal and cooperative funds, by States, June 30, 1934

State	Fiscal year 1934				Total to June 30, 1934		Expenditures to June 30, 1934		
	Miles constructed		Miles maintained		Miles constructed		Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails	Roads	Trails			
Ala.....	45.9		182.8		117.3		\$537,636.32	\$25,278.16	\$562,914.48
Alaska.....	8.2	182.9	239.4	564.5	260.6	770.1	7,354,146.86	329,262.27	7,683,409.13
Ariz.....	520.8	144.5	3,985.1	2,699.0	2,984.1	2,069.1	10,826,316.50	1,158,087.95	11,984,404.45
Ark.....	450.9		1,111.0	923.0	1,167.9	571.4	3,233,974.59	135,929.75	3,369,904.34
Calif.....	2,651.5	370.5	13,857.2	21,056.9	8,081.6	11,894.2	33,425,979.87	8,612,252.47	42,038,232.34
Colo.....	158.7	118.4	1,229.2	10,355.2	1,798.4	11,888.9	11,314,473.26	1,082,295.13	12,396,768.39
Fla.....	412.5		376.0		1,029.2		1,138,570.12	146,179.84	1,284,749.96
Ga.....	149.8	8.0	148.3	351.9	313.9	359.9	1,376,903.42	82,949.62	1,459,853.04
Idaho.....	1,073.3	323.5	4,442.8	25,046.0	4,454.2	20,711.6	25,408,712.87	1,898,002.49	27,306,715.36
Ill.....	50.2		22.0		50.2		297,153.27		297,153.27
Kans.....					3.4		2,111.51		2,111.51
Ky.....	56.0		16.2		56.0		354,318.98		354,318.98
La.....	156.6		153.9		310.5		189,976.09		189,976.09
Maine.....	9.5	19.3	10.4	74.0	19.9	86.5	129,011.13		129,011.13
Md.....							70.05		70.05
Mich.....	528.2		1,103.3		1,154.6		816,639.52	91,180.97	907,820.49
Minn.....	187.3	28.1	312.4	163.9	701.0	613.7	1,607,418.27	291,478.99	1,898,897.26
Miss.....	749.6				758.6		600,867.51		600,867.51
Mo.....	191.0		50.0		191.0		628,219.14		628,219.14
Mont.....	480.8	62.1	3,300.2	21,031.0	1,819.9	19,473.1	14,568,716.36	659,505.24	15,228,221.60
Nebr.....	18.7		78.0		70.2		147,866.89	990.80	148,857.69
Nev.....	59.4	17.0	374.0	1,322.0	621.1	937.4	2,535,606.55	175,636.09	2,711,242.64
N. H.....	26.2	107.2	308.5	580.0	97.8	687.2	903,384.85	95,949.70	999,334.55
N. J.....							217.71		217.71
N. Mex.....	411.7	49.0	2,305.3	3,270.8	1,773.2	1,683.8	8,146,671.27	332,357.17	8,479,028.44
N. Y.....							81.32		81.32
N. C.....	144.6	23.3	347.2	684.3	385.3	700.1	1,978,962.84	467,333.49	2,446,296.33
N. Dak.....					1.0		57.75		57.75
Okla.....	47.5		61.2	1.5	98.9	16.5	227,606.42	15,847.08	243,453.50
Oreg.....	1,443.2	348.9	10,164.1	15,552.0	6,199.7	9,051.8	24,092,088.92	8,185,542.74	32,277,631.66
Pa.....	69.4	21.0	192.1	201.8	141.4	222.8	1,190,880.20	42,185.50	1,233,065.70
P. R.....	.9	1.5		36.3	7.5	37.8	220,798.32	550.00	221,348.32
S. C.....	67.9		45.2	18.2	74.2	18.2	249,565.48	15,659.81	265,225.29
S. Dak.....	46.6		275.7	40.5	401.9	85.1	1,452,545.77	244,046.11	1,696,591.88
Tenn.....	194.3	100.0	249.6	552.8	328.6	917.8	1,467,963.39	189,884.30	1,657,847.69
Tex.....							1.08		1.08
Utah.....	417.4	149.9	1,577.9	5,093.8	1,742.1	3,875.3	6,296,498.47	995,717.33	7,292,215.80
Vt.....	5.2	13.2	3.5	25.3	7.2	13.2	102,086.01		102,086.01
Va.....	177.9	35.0	328.0	917.3	421.0	962.4	1,847,263.36	106,400.35	1,953,663.71
Wash.....	802.1	277.3	3,222.2	14,594.0	2,583.8	8,932.4	15,606,584.67	1,727,633.42	17,334,218.09
W. Va.....	173.2	45.0	203.0	202.0	374.8	605.2	1,138,094.54	38,159.30	1,176,253.84
Wis.....	419.5		453.0		597.7		490,434.69	1,820.00	492,254.69
Wyo.....	123.6	79.0	996.4	6,024.2	1,242.8	2,620.3	7,104,430.88	399,944.98	7,504,375.86
Total.....	12,530.1	12,524.6	51,725.1	131,382.2	42,442.5	99,805.8	189,010,907.02	27,540,061.05	216,558,968.07

TABLE 17.—*Distribution among the States of the road and trail apportionments for the fiscal year 1935*

State	10 percent fund	Emergency construction forest highways	Forest-road development	Total
Alabama.....	\$18. 01	\$6, 292	\$8, 294	\$14, 604. 01
Alaska.....	4, 771. 43	671, 067	20, 160	695, 998. 43
Arizona.....	22, 000. 24	422, 607	133, 416	578, 023. 24
Arkansas.....	12, 361. 94	76, 504	61, 462	150, 327. 94
California.....	52, 518. 43	1, 025, 151	578, 314	1, 655, 983. 43
Colorado.....	38, 767. 01	531, 025	125, 812	695, 604. 01
Florida.....	2, 038. 14	32, 975	18, 165	53, 178. 14
Georgia.....	868. 76	15, 820	17, 418	34, 106. 76
Idaho.....	32, 799. 35	740, 576	483, 508	1, 256, 883. 35
Illinois.....		2, 051	5, 151	7, 202. 00
Kentucky.....		4, 128	11, 530	15, 658. 00
Louisiana.....	31. 05	11, 014	7, 189	18, 234. 05
Maine.....	175. 27	2, 289	1, 106	3, 570. 27
Michigan.....	1, 143. 44	35, 523	97, 472	134, 138. 44
Minnesota.....	919. 48	68, 175	44, 100	113, 194. 48
Mississippi.....	38. 87	19, 799	6, 912	26, 749. 87
Missouri.....		9, 749	20, 203	29, 952. 00
Montana.....	16, 890. 67	580, 574	237, 314	834, 778. 67
Nebraska.....	498. 28	6, 975	5, 763	13, 236. 28
Nevada.....	7, 571. 88	132, 492	13, 904	153, 967. 88
New Hampshire.....	2, 597. 98	36, 784	14, 375	53, 756. 98
New Mexico.....	10, 050. 45	297, 117	111, 384	418, 551. 45
North Carolina.....	2, 780. 73	22, 380	23, 224	48, 384. 73
Oklahoma.....	475. 67	5, 858	1 108, 937	115, 270. 67
Oregon.....	28, 039. 78	967, 688	344, 208	1, 339, 935. 78
Pennsylvania.....	783. 15	15, 004	14, 681	30, 468. 15
Puerto Rico.....		964	830	1, 794. 00
South Carolina.....	236. 55	9, 362	4, 700	14, 298. 55
South Dakota.....	5, 912. 97	56, 954	36, 441	99, 307. 97
Tennessee.....	857. 51	19, 724	21, 289	41, 870. 51
Texas.....		6, 770	3, 000	9, 770. 00
Utah.....	19, 294. 32	243, 870	62, 555	325, 719. 32
Vermont.....	453. 07	4, 147	4, 382	8, 982. 07
Virginia.....	953. 55	25, 858	24, 884	51, 695. 55
Washington.....	45, 411. 29	527, 466	210, 843	783, 720. 29
West Virginia.....	176. 31	20, 635	31, 104	51, 915. 31
Wisconsin.....	58. 11	27, 001	84, 354	111, 413. 11
Wyoming.....	17, 651. 18	317, 632	101, 616	436, 899. 18
Total.....	329, 144. 87	7, 000, 000	3, 100, 000	10, 429, 144. 87

¹ Includes \$100,000 truck trails and trails under National Industrial Recovery Act, fiscal year 1935.

TABLE 18.—*Distribution among the States of the total road and trail apportionments, including the fiscal year 1935*

State	10-percent fund	Section 8	Federal forest-road construction	Forest highways ¹	Forest road development ²	Improvement ³	Total
Alabama	\$1,045.91	\$15,456.04	\$1,922.31	\$80,798	141,478	\$31,077.06	\$271,777.3
Alaska	175,580.88	470,963.60	203,229.50	7,316,251	329,274		8,495,298.9
Arizona	701,493.80	677,956.45	490,434.11	6,227,179	2,141,787	546,273.39	10,785,123.7
Arkansas	144,427.33	175,126.19	128,423.38	939,822	904,998	295,897.47	2,588,694.3
California	1,785,673.34	1,464,333.82	1,201,431.20	15,005,860	7,734,879	1,518,217.76	28,710,395.1
Colorado	849,662.25	770,948.34	784,259.55	7,393,963	2,365,045	197,297.57	12,361,175.7
Florida	48,092.00	119,528.14	21,534.94	326,597	209,000	140,417.47	865,169.5
Georgia	13,900.76	52,393.57	130,443.73	210,073	324,927	133,229.53	864,967.5
Idaho	1,046,898.88	1,176,750.85	1,337,004.17	11,059,164	9,237,490	1,827,886.55	25,685,194.4
Illinois				22,283	5,547		27,830.0
Kansas	1,867.27						1,867.27
Kentucky	722.72			28,819	133,980		163,521.7
Louisiana	88.67			42,104	65,946	38,132.47	146,271.1
Maine	4,155.30	32.41	3,738.77	30,621	37,972	21,909.56	98,429.0
Maryland	70.05						70.05
Michigan	5,454.16	115.63	3,000.00	227,402	388,116	164,507.86	788,595.6
Minnesota	45,933.13	8,036.36	108,352.03	737,696	568,248	130,348.59	1,598,614.1
Mississippi	38.87			60,075	103,399	8,598.45	172,111.3
Missouri				31,237	20,203		51,440.0
Montana	643,433.03	762,523.77	764,035.26	8,749,984	4,400,122	651,377.24	15,971,475.3
Nebraska	21,321.21	18.98		105,475	50,898	578.27	178,291.4
Nevada	197,080.54	192,989.88	81,491.85	2,051,257	193,247	45,878.18	2,761,944.4
New Hampshire	55,819.57	7,165.35	10,941.30	453,247	259,746	56,487.05	843,406.2
New Jersey	118.99				83		201.9
New Mexico	380,007.46	426,086.04	518,426.97	4,497,653	1,688,833	408,824.28	7,919,830.7
New York	4.00				20		24.00
North Carolina	43,773.92	86,336.41	176,466.28	333,485	713,483	192,530.92	1,546,075.5
North Dakota	45.75	7.00					52.75
Oklahoma	11,639.42	65.49	2,775.17	68,243	182,642	35,700.19	301,065.2
Oregon	1,099,437.22	1,428,785.95	1,013,981.59	13,547,726	6,681,700	876,916.07	24,648,546.8
Pennsylvania	6,672.47	7,724.04	21.42	161,043	232,826	79,976.40	488,263.3
Puerto Rico	150.44	7.00	3,309.09	12,805	28,835	4,714.52	49,855.0
South Carolina	3,490.23	402.10	48,028.61	54,947	78,666	171.08	185,705.0
South Dakota	198,939.16	87,106.45	78,652.52	827,447	334,754	33,879.18	1,560,778.3
Tennessee	21,978.10	106,854.56	27,967.79	272,079	381,206	100,304.31	910,389.7
Texas				21,095	3,000		24,095.0
Utah	454,470.67	464,918.34	512,489.56	3,668,451	1,071,943	183,090.76	6,355,363.3
Vermont	487.47			17,887	54,211	10,778.15	83,863.6
Virginia	49,119.31	58,390.16	71,784.26	355,446	460,681	154,268.85	1,149,689.5
Washington	749,725.04	958,090.33	732,302.49	7,510,278	4,931,063	862,891.32	15,744,350.1
West Virginia	6,507.75	12,830.41	5,049.24	168,870	351,883	208,604.94	753,745.3
Wisconsin	121.36			110,494	223,108	98,415.88	432,139.2
Wyoming	497,621.74	468,056.34	538,468.91	4,772,144	1,564,761	102,815.87	7,943,867.8
Total	9,267,070.17	10,000,000.00	9,000,000.00	97,500,000	48,600,000	9,161,997.19	183,529,967.3

¹ Includes \$3,000,000 appropriated for emergency highways within national forests, fiscal year 1931; \$5,000,000 emergency forest highways, fiscal year 1933; and \$15,000,000 for forest highways under the provisions of section 205 of the National Industrial Act.

² Includes \$10,000,000 truck trails and trails appropriated under the provisions of section 205 of the National Industrial Act, fiscal year 1934, and \$100,000 fiscal year 1935.

³ Includes actual road and trail expenditures made from annual funds.

TABLE 19.—*Condition of forest-road funds on June 30, 1934*

Fund	Appropriations	Expenditures	Balance
Ten-percent	\$8,937,925.30	\$8,346,902.14	\$591,023.16
Section 8	10,000,000.00	10,000,000.00	
Federal forest-road construction	9,000,000.00	9,000,000.00	
Forest highways ¹	73,417,400.00	72,829,759.03	587,640.97
Forest highways—N. R. A.	15,000,000.00	5,199,660.56	9,800,339.44
Forest-road development	35,500,000.00	34,906,938.09	593,061.91
Forest-road development—N. R. A.	10,000,000.00	6,261,904.34	3,738,095.66
Improvement ¹	9,161,997.19	9,161,924.86	
Total	171,017,322.49	155,707,181.87	15,310,140.62

¹ Includes emergency funds.

The Agricultural Appropriation Act for the fiscal year 1935 made available only \$1,500,000 of the \$2,082,600 unappropriated portion of the 1933 \$12,500,000 authorization, leaving a balance of \$582,600 of the regular forest-highway authorization subject to later appropriation. The expenditure on forest highways in Alaska was again limited to \$350,000, as in the two immediately preceding agricultural appropriation acts. The Hayden-Cartwright Act authorized the appropriation of \$10,000,000 for each of the fiscal years 1936 and 1937, for forest highways and forest-development roads under the provisions of section 23 of the Federal Highway Act; and the Deficiency Act of June 19, 1934, appropriated \$10,000,000 for 1935, thus making available \$7,000,000 for forest highways and \$3,000,000 for forest-development roads and trails. These amounts will be apportioned to the national-forest States on the same basis as the regular forest-highway and forest-road-development funds.

At the close of the year the \$15,000,000 allotted for forest highways under the National Industrial Recovery Act, as specified in last year's report, was practically all under contract, and about 72 percent of the \$10,000,000 allotted for national-forest roads, trails, bridges, and related projects had been expended or obligated.

MAPS AND SURVEYS

The Forest Service compiled, traced, and had published for official use 17 quarter-inch scale maps, 17 half-inch scale maps, and three 1-inch scale maps of individual national forests. There were also prepared and published 5 maps to accompany Presidential Executive orders, and 3 United States Geological Survey quadrangles showing in color tints the vegetative types and listing the various species. Small editions of 37 miscellaneous small maps, charts, tables, graphs, and illustrations were issued.

Scattered areas totaling approximately 2,300 square miles of the national forests in Western States were mapped to the accuracy and scale required for forest administration.

RESEARCH

The funds made available for research activities during the fiscal year 1934, under various appropriation items and through executive allotments, are shown in table 20, in comparison with the amounts appropriated for 1933 and appropriated and allotted for 1935.

TABLE 20.—*Appropriations and allotments of Federal funds for research, 1933-35*

Class of research	1933 ¹	1934			1935		
		Appropriated ¹	Allotted ²	Total	Appropriated	Allotted	Total
Forest management.....	\$497,181	\$386,095	\$72,426	\$458,521	\$392,810	\$168,084	\$560,894
Range investigations.....	111,922	78,386	47,367	125,753	81,025	95,692	176,717
Forest products.....	556,425	444,376	-----	444,376	459,725	150,000	609,725
Forest survey.....	157,221	125,205	275,749	400,954	³ 118,543	615,810	734,353
Forest economics.....	64,692	47,126	15,566	62,692	48,493	20,164	68,657
Erosion and stream flow.....	82,973	65,341	40,535	105,876	³ 67,642	182,362	250,004
Forest taxation.....	38,023	27,713	-----	27,713	30,700	-----	30,700
Forest insurance.....	12,000	8,046	-----	8,046	14,300	-----	14,300

¹ Amounts made available by the Agricultural Appropriations Act less the amounts withheld under the provisions of the Economy Act and by the Bureau of the Budget.

² Amounts made available through allotments from emergency appropriations.

³ Allocated from National Industrial Recovery Act funds in lieu of regular appropriations. See p. 12.

The amounts shown as appropriated for the fiscal year 1934 are somewhat greater than the showing in last year's report, as a result of the law restoring two-thirds of the salary cut made by the Economy Act.

FOREST ECONOMICS

Dependable data in the field of forest economics are essential for economic and social planning. The primary purpose of the forest-economic investigations pursued during the year has been to obtain and interpret data needed and called for by public administrators, economists, and industrialists.

An example is the study of tax delinquency. That this is wide-spread throughout forested and cut-over regions is well known, but its underlying causes, its actual extent, and its probable future trends have been matters of speculation. Accurate knowledge of the character and amount of forest land that is being abandoned and of the reasons for its abandonment is essential for the proper shaping of public policy. The study of this subject was continued in the Lake States, the South, and the Pacific Northwest.

In the last-named region tax-delinquent and reverted forest areas in 18 representative counties have been listed and mapped, and in several of these counties data have been gathered on trends in values, values by property classes, taxes levied, taxes uncollected, population, public debt, and the intent of forest-land owners. In the forest section of western Washington and Oregon more than 6,000,000 acres were found to be tax-delinquent. Before the findings of the study were completed, large and effective use of the data gathered was made by county courts, tax agencies, and several research agencies; many miscellaneous requests for statistical and map data were filled; some of the facts developed were reported at conferences and in public addresses; and regional interest in the abandoned forest-land problem broadened perceptibly. Washington State College, the University of Washington, and Oregon State College made use of the results of the study in connection with allied projects of their own.

In the South, the tax-delinquency study in Arkansas was virtually completed and a report is being prepared for publication. Similar studies are under way in Mississippi, Louisiana, and Georgia. The basic data compiled in these studies are in great demand by State and Federal agencies, universities, and others. In the Lake States, four counties in upper Michigan were intensively studied and a bulletin was prepared for publication.

Partly as a result of the time and cost studies reported in 1933, logging methods in the Douglas fir region are undergoing rapid change. Studies of further adaptation of logging methods to sound timber-management requirements were continued. A report on timber management is virtually completed dealing with the most effective methods of placing forest properties on a sustained-yield basis by the use of this new logging technique. The results of a detailed time and cost study made in a typical ponderosa pine logging operation in western Montana were analyzed and made available to the industry, and a report was completed for publication. The study indicates that clean-cutting is seldom the most profitable method, and that if the method of economic selection is substituted the production of select grades of pine lumber may be increased by as much as one-third. These studies contribute directly to the development of practical methods of carrying out the conservation provisions of the lumber code.

The forest-insurance study was completed for the sugar pine, ponderosa pine, and redwood regions of California. The essential conclusion is that the extent and character of the losses set up no real reason why forest-fire insurance should not be able to operate successfully in these regions.

Records of 1933 stumpage and log prices in all forest regions were urgently requested by the Lumber Code Authority and were compiled and prepared for publication.

FOREST SURVEY

An unprecedented demand for the detailed information that is being gathered by the Forest Survey has come both from regions where dependable data could be furnished and from regions in which it has not yet been possible to initiate work. The survey has had to be planned and conducted as a Nation-wide undertaking, to be prosecuted first where related problems were most acute. Emergency funds have speeded up the work both in the field and the office, and have enabled much-needed data to be obtained and released far more promptly than the curtailed regular appropriation would have permitted. A difficult problem of the rapid expansion of the work has been the enlisting and training of the highly specialized and technical personnel necessary.

In the Pacific Northwest, the preliminary inventory data gathered in the Douglas fir region were compiled by counties and for each State as a whole, and released in mimeographed form. The depletion phase of the survey was completed; and the growth phase is well under way. Generalized type maps for the entire region were completed. Field work was commenced in the ponderosa pine region of eastern Oregon.

In the South, the inventory was completed on nearly 33,000,000 acres, including portions of the bottom land hardwood region of the Mississippi River, the shortleaf-loblolly pine region of Mississippi, the longleaf-slash pine belt of Florida, Georgia, and South Carolina, and the upland hardwoods area of Mississippi. At the request of the Tennessee Valley Authority, the survey was extended to the watersheds of the Clinch and Powell Rivers, above the Norris Dam. Office compilation and analysis work are proceeding rapidly.

In the Lake States, 20,000,000 acres in Minnesota were surveyed, and office computational work was started; and office compilations were completed for two counties in Michigan, on which field work had been done previously. In the "Inland Empire" inventory field work is under way on 10,000,000 acres, and timber estimates were collected on an additional 500,000 acres. In California, cover-type maps of approximately 4,650,000 acres, in eight additional counties, were prepared for publication.

The major effort on the requirements phase has been devoted to rural construction. A detailed canvass was made of 15 carefully selected sample counties throughout the country. A very close relationship between soil classification, types of farming, and farm buildings is evident. Studies of lumber requirements for urban construction, particularly housing, were continued.

A study of lumber used by secondary wood-using industries in 1933 was begun, in response to a request from the Lumber Code Authority.

FOREST TAXATION

A formal report of the Forest Taxation Inquiry is complete and ready for publication. A preliminary announcement of the principal conclusions and recommendations was distributed. Several States have requested assistance in applying the recommendations of the inquiry, and it is planned to carry on local application studies of this character.

FOREST-MANAGEMENT INVESTIGATIONS

Emergency activities created new outlets for forest-management research data, to meet varied requirements. One of the outstanding demands grew out of the establishment of the lumber code, under which the lumber industry established a series of rules of forest practice. Separate rules to bring about adequate restocking and protection were set up for each of the major timber-producing regions. These rules were very largely based upon the investigations of many years in virtually every important forest type. Of particular value were those relating to methods of cutting, selective logging, slash disposal, fire control, and growth. Other studies that in the aggregate were heavily drawn upon concerned the distance seed is carried by the wind, the age of seed-bearing trees, the number of seed trees necessary per acre, the number and distribution of trees needed to make a stand, the effect of slash disposal upon reproduction, establishment, and growth, the rate at which understocked forest stands develop, and many more details. The development of a marketing agreement between the turpentine and rosin producers and the Agricultural Adjustment Administration called for information on conservative methods of naval stores practice. Outstanding among the achievements of this agreement is the clause establishing 9 inches as the minimum diameter for chipping and 14 inches as the minimum for two faces. By adopting this clause the naval stores industry has taken its longest step forward in conservation since the coming into use of the Herty cup system.

Other agencies that drew upon the results of silvical research included the Reconstruction Finance Corporation and the Farm Loan Board, in connection with loans on forest properties. The data sought for this purpose concerned growth and potential yields, forest practices, fire-protective measures necessary to maintain the forest, and the like. Protective clauses insuring conservative handling of the forest were included in many of these loans. But probably the

greatest call arose in connection with the activities of the Civilian Conservation Corps. In practically every region, research findings were put into immediate application on large areas of forest. Data were furnished administrative agencies on methods to be used in such stand-improvement measures as the conversion of fire-scarred and defective second-growth into productive stands, releasing reproduction of desirable species overtopped and suppressed by worthless weed trees, poisoning and girdling "wolf" trees, and using toxic chemicals to destroy sprout and chaparral growth. Three publications and many mimeographed articles outlining silvicultural practices were issued to meet the specific needs of the corps.

SILVICAL AND NAVAL STORES RESEARCH

Investigations continue to demonstrate that good silviculture is likely to be good business. In the northern hardwoods, studies of the Lake States Forest Experiment Station showed an annual growth varying from 100 up to 250 board feet per acre, the amount depending upon how heavily the original stand was cut; the best growth was obtained when not more than about 60 percent of the original volume was removed. Selective cutting realized from \$10 to \$20 per thousand feet for stumpage and profit, while the mortality in the stands left was less than 0.5 percent and the fire hazard was far lower than where heavier cutting was practiced. In the redwood region of California, where clear cutting has been the rule, preliminary results show that selective logging with tractors is possible and affords greater returns to the operator.

Work in the western white pine type indicated some of the reasons why pine reproduction is obtained so sporadically. Dormant seed which has lain in the litter and duff for more than 2 years is not viable, so that reproduction from this source cannot be depended upon unless a heavy seed crop occurred within 2 years before the cutting. When seed trees are present enough seedlings appear from time to time to furnish adequate stocking if they live, but a stand is not assured until the seedlings are more than 3 years old. The chief causes of early seedling mortality are drought and high soil-surface temperatures, which in the hottest periods are from 120° to 150° F; and the losses of seedlings are greatest on clear-cut areas and least in half shade.

Attention was given to the relationship between lack of climatic moisture and the distribution of tree species, both natural and through forest planting. Laboratory studies at the Lake States Forest Experiment Station show that jack pine is the most resistant of the native conifers, followed by Norway pine, white pine, and white spruce. Plants grown with either a low or a too-abundant nitrogen supply were found less resistant to drought than well but not too-heavily fertilized plants; those grown in the shade were less drought-resistant than those grown in full sunlight; seedlings seem to be more drought-resistant than transplants with tops of equal size; and plants grown with a normal supply of water are likely to be more drought-resistant than those grown with either a meager or an excessive supply.

Beginning about 1870, there was much tree planting in the prairie region for several decades. In North Dakota most of the plantings were for protection from wind. Recently, with recurring drought, many of the trees have died. A field study showed that much of the loss was due to a poor choice of species, to grazing, and to lack of care. Planting was feasible where the precipitation did not fall below 16 or 18 inches. In North Dakota, the Carolina poplar should not be used, willow can be used only on very moist sites, and boxelder and cottonwood are satisfactory except on the driest sites. Green ash is the most desirable hardwood species, and ponderosa pine, Scotch pine, and Rocky Mountain red cedar are the best conifers. With proper selection of species and sites and with good care, a planted grove should last 65 years or more.

Woodland grazing in the Central States was studied further. In general, it converts forest into open pasture. Surveys throughout Indiana indicate that fully 50 percent of the grazed farm woods have already reached the stage where they are no longer capable of yielding forest products.

In American reforestation enterprises little attention has so far been paid to the source of seed, although it is well recognized abroad that seed source is of real concern in large-scale planting. In 1912, Douglas fir seed was collected in Oregon and Washington from trees of different ages, growing in different localities, on different sites, at different altitudes, and in stands of different density and health. Some 12,000 trees grown from this seed were

planted in several different localities and at different elevations. The plantations now show that age, quality of site, growing space, and fungus infection of the parent tree had no effect upon the height growth of the progeny. At high elevations stock from seed produced at high elevations made faster growth than stock from seed produced at lower elevations; but when the planting was at low elevations the reverse was true. Two localities furnished trees that were consistently taller in each plantation than the average tree, but no specific characteristic of the parent or site explained this outstanding vigor. Mortality in the plantations was not affected by the seed source, but trees from one locality were injured severely and consistently by frost. In the Lake States, Norway pine trees produced from seed gathered in the southern part of the tree's range, when planted in the northern part, made faster and sturdier growth but were less drought-resistant than trees from seed of northern origin. Trees from northern seed when planted in central Michigan or Wisconsin develop much more slowly than the local stock.

Naval stores work in the Southeast continued to demonstrate the value of conservative working. Conservative chipping adds nothing to the operator's cost but obtains from 20 to 50 percent more gum per face and extends the workable life of the timber. With narrow streaks trees maintained their full gum yields for 8 years.

After 2 years of working, 41 percent of the trees chipped 6 days a week were dry-faced; of those chipped 3 times a week, 30 percent; of those chipped twice a week, 13 percent; of those chipped but once a week, none. Tacking the tin gutters to the tree instead of inserting them deeply in the wood increases the yield of gum from longleaf over a 5-year period by from 15 to 20 percent, and the yield from slash pine by from 15 to 30 percent.

FIRE RESEARCH

In the past few years forest-fire research has contributed substantially to better fire control. Detailed analysis of the records of thousands of fires led up to the development of more systematically planned detection, transportation, and communication. In detection planning the way was shown to better distribution of man power, making it possible to cover a larger area by a given number of look-outs without duplication and with increased efficiency. Transportation planning made possible greater speed of attack. With the aid of emergency funds, plans embodying the principles discovered through fire research were put into practical effect on large areas of national-forest, national-park, State, and other forest lands. The forest experiment stations not only developed the technic for applying the work, but also trained many administrative men detailed for the purpose. In one case 30 men were given special training, and over 1,200 visibility maps were prepared.

Laboratory studies of the effect of background, light intensity, and observation direction indicated that further field studies of visibility were needed. With the aid of members of the C. C. C. 201 carefully controlled forest fires were set and observed, under a wide variety of conditions, by the California Forest Experiment Station. Distance up to 20 miles affected the detection time only slightly. The direction of the sun, relatively to the fire, was an important factor. Suspended particles in the air greatly affected visibility, but fires were detected up to 7 miles away even through the drift smoke from the great Tillamook fire in Oregon. Under the most favorable conditions smoke became visible in about 8 minutes; under moderately poor conditions in 12 minutes. The normal lag between the start of the fire and the rise of the first smoke was about 4 minutes. The rate at which fires spread was an important factor in detection time.

Lightning causes close to half of all fires on the national forests of Oregon and Washington, with an average of 720 annually. They create a difficult suppression problem because they usually occur at inaccessible places and may occur in large numbers on a single day. For 7 years the look-outs in these States have been observing lightning storms, and more than 6,000 reports have been made. Maps of the path of these storms do not disclose any definite lightning-storm lanes or frequent "breeding" spots. General storms affecting a large area at about the same time cause two-thirds of the fires but occur only on one-sixth of the number of days with lightning. Every general storm, but only 44 percent of the local storms, started fires. Most of the individual storms were from 11 to 60 miles long, moved at a rate of from 6

to 20 miles an hour, and traveled in a general northerly direction. On a day of general storm several individual storms originated simultaneously at points 50 or more miles apart. Although definite zones of storm frequency were found the distribution of the fires within these zones varies too widely from year to year to make the zones reliable indicators of where fires will occur in a given year. The number of fires and the number of storms, however, vary in an approximate ratio with each other.

Human judgment of fire weather often fails at critical periods because man is unable to integrate all the factors properly. Considerable study has been given to the development of cheap and simple field instruments that will do this with reasonable accuracy. A combination of instruments was devised by the Pacific Northwest Forest Experiment Station, which includes a rain gage, a wind-velocity gage and wind vane, a psychrometer, and a fuel-inflammability indicator, and costs less than \$25 to construct. The set is designed to aid timberland operators and fire-control agencies in rating current fire danger. Over 150 of the sets are now in use. For recording fire-weather factors at places not continuously occupied, the Northern Rocky Mountain Station perfected an instrument which records moisture of fuel, both duff and wood, and wind velocity. As an aid in cutting firebreaks, a power brush saw was developed at the California Station. This machine operates with a 1½-horsepower gasoline motor, weighs 100 pounds, and carries 12-inch circular saws. It proved quite successful in dense brush and in stands of small saplings.

EROSION AND STREAM-FLOW INVESTIGATIONS

Erosion-control measures, developed chiefly by the forest and range experiment stations, were applied on western forest and range lands by about 100 camps of the C. C. C. and by other emergency agencies. The restoration of vegetative cover to check erosion and floods is now progressing on some 150,000 acres. Supplemental features are the construction of approximately 40,000 check dams and about 160 miles of fence, the plowing of innumerable contour furrows, the building of many dikes to spread water over drained meadows and similar work.

An outstanding example is what is being done along the Wasatch Mountain front, in Utah. Recent floods from these mountains have destroyed homes and other urban property, buried highways and valuable farm lands under several feet of boulders, gravel, and other erosion debris, and resulted in the loss of several lives, besides property losses aggregating more than a million dollars. Small head-water areas of private land where the vegetative cover has been seriously depleted or destroyed by overgrazing, fire, and to some extent by timber cutting were the cause. Control measures are being centered principally on restoring vegetative cover on these critical head-water areas, each embracing from a few hundred to a few thousand acres of land. Denuded areas are being planted. On the steeper slopes contour furrows have been plowed to prevent seed wash, to provide a better seed bed, and to conserve maximum moisture. Fences are built to exclude livestock. Despite drought, satisfactory vegetative stands have already been established sufficiently to check run-off and to initiate soil-binding. Small check dams have also been built in gullies to retard cutting until revegetation is completed.

Water users of the Boise irrigation project, in Idaho, are profiting from erosion-stream-flow research carried on by the Intermountain Forest and Range Experiment Station. A remarkably close correlation was found between the annual snow-water content on representative watershed areas of that project and the Boise River flow. This made it possible to forecast a discharge in 1933 that would permit filling both the main Arrowrock and the supplementary reservoir, and those in charge of the project confidently filled both despite the belief of water users that the supply would be insufficient. The result was a more equitable distribution of water and an elimination of waste.

Continued studies of surface run-off and erosion from the main herbaceous types on the Boise River watershed demonstrated the marked superiority of the bunch-grass type over the annual weed and downy-chess types in controlling erosion. The two latter types are, in fact, stages of depletion caused by overgrazing of the bunch-grass vegetation. Under light to medium rains, there is little difference in either the run-off or the erosion from all three types, though the annual-weed type is the least valuable; but under cloudburst rains annual-weed areas had 11 times and downy chess areas more than 4 times the

erosion from the bunch-grass areas. Under treatment simulating trampling, erosion more than trebled on the annual-weed type and increased sevenfold on the downy chess type, but only doubled on the bunch-grass type. With a combined heavy rainfall and trampled conditions, the erosion on the annual-weed type was approximately 21 times and that on the downy chess 19 times as great as on the bunch grass.

Intensive experiments carried on by the Southwestern Forest and Range Experiment Station in Arizona emphasized the value of side-oats grama, a perennial characteristically found on properly managed ranges, in controlling surface run-off and erosion. During the hard rains of the summer of 1933, an area supporting a 31-percent cover of side-oats grama suffered only one-third the erosion and three-fourths the surface run-off that came from a similar area supporting an 18-percent cover of snakeweed and a small amount of side-oats grama. Under showers and light rains the difference was small. It must be borne in mind, however, that depletion from overgrazing is most severe in abnormally dry years, that in these years there is a critical balance between soil moisture and the growth requirements of plants, and that even in these years torrential summer rains are common. They have been known to precipitate as much as 0.75 inch in 5 minutes. On overgrazed ranges most of this water runs off, carrying away fertile topsoil and leaving but little moisture in the remaining soil. On properly utilized ranges, with higher vegetative density, more water is retained and less runs off with erosive violence. A depleted range area in Arizona lost 264 cubic feet per acre of soil and other erosional debris in a single storm. Such results emphasize the importance of restoring perennial grasses on the depleted range of important watersheds as rapidly as possible.

A disastrous flood in Los Angeles County on January 1, 1934, caused the loss of 34 lives, focused public attention on the source of the flood in a fire-denuded watershed, and demonstrated the value of forest cover and the economic wisdom of safeguarding it. A special study of this flood was made by the California Forest and Range Experiment Station. The storm which caused the flood extended over a wide belt of foothills and mountains and deposited an average of 12 inches of rain within 2½ days over a 50-mile front. The watershed from which the flood was discharged—a flood more of mud than of water—comprises 4,000 acres, recently burned over. Neighboring watersheds subject to the same rainfall but with their forest cover intact yielded clear water which caused no unusual erosion and no serious damage. The maximum flood discharge from the burned-over drainage basin reached 1,100 second-feet per square mile, carrying some 67,000 cubic yards of eroded debris. The run-off in San Dimas Canyon, a few miles distant, was only 51 second-feet per square mile and carried only 56 cubic yards of eroded material.

Other studies of the effect of fire on run-off and erosion were continued elsewhere. In the pine region of the Sierras, a 5-year record of the run-off and erosion from repeatedly burned and comparable unburned plots has shown a yearly run-off from the burned area ranging from 31 to 463 times that from the unburned, and a yearly erosion ranging from 22 to 239 times that from the unburned. The run-off from a plot allowed to revegetate after a single burning exceeded the run-off from an unburned check plot by 31 times the first year, as against 11, 5, 15, and 14 times in the subsequent 4 years; and after carrying off 485 times as much eroded material the first year as the check plot, it carried the second year only 81 times as much. In Mississippi a burned-over forest plot eroded at the rate of 1,669 pounds per acre, and a burned-over broomsedge plot at the rate of 1,587 pounds, while unburned check plots yielded only nominal amounts.

FOREST-PRODUCTS RESEARCH

The broad objective of forest-products research is efficient utilization of the forest crop. The uses of competing materials have been vastly expanded and diversified through scientific study, experiment, and invention. Research can similarly enlarge the serviceability of and markets for forest materials. Better yields from available stands, better knowledge and adaptation of wood properties, increased refinement and variety of product, and utilization of neglected species and of material now wasted are among the outstanding objectives.

The Forest Products Laboratory, though handicapped by reduced appropriations in a critical period, had the partially offsetting benefit of considerable allotments of emergency funds. During the term of C. W. A. relief, prog-

ress was speeded by the addition of 51 temporary employees on research projects and 60 on maintenance and clerical work. The outcome more than repaid the time expended by the regular staff in training and supervision. Many tasks needing to be done were assumed by highly qualified personnel who took a keen interest in the work. Improvements in the physical plant and equipment of the Laboratory were made both through C. W. A. help and under N. R. A. allotments. Working conditions were bettered, and research was more adequately supplied with suitable apparatus.

REGIONAL UTILIZATION STUDIES

The less-esteemed southern hardwoods have potentialities for industrial utilization of high importance in connection with land use and the employment of labor over thousands of square miles of territory. The Forest Products Laboratory continued its special investigations relating to these woods and their uses. Further information was obtained correlating the density and the growth rate of hickory, persimmon, tupelo gum, and ash with flood conditions on the site. Preliminary results of the two selective logging studies begun last year on red and water oaks, cow oak, red gum, and ash indicated that for profitable cutting the minimum diameter should range from 16 to 17 inches, as against 14 inches for Lake States hardwoods. Supplementing the large collection of lowland hardwood specimens obtained last year, samples of 12 species were added from the general region of the Tennessee Valley, and all were examined with respect to density, warping and shrinking, texture, straightness of grain, and comparative gluing and bending properties. The wide variation that has been found in the general quality and working properties of southern hardwood species accounts for much of the commercial discrimination against them, and focuses more clearly the problem of segregation according to properties.

Experiments in the new steeping process for drying the southern swamp oaks in heavy-plank sizes continued, along with detailed studies of the shrinkage of the heartwood and sapwood. In most of the seasoning work a solution of common salt was used, but exploratory tests were made with other chemicals, the best of which was monoammonium phosphate. The steeping method holds the promise not only of quick and satisfactory seasoning of difficult woods, but of affording a practical means at the same time of fireproofing and rendering resistant to decay and insect attack. A nonroyalty patent on the technic developed has been applied for.

Studies of specific uses for southern hardwoods gave interesting results. Office tables were made from salt-seasoned swamp-oak lumber and are proving satisfactory and serviceable in all respects, the finished wood showing no tendency to "weep" in damp weather. Laboratory demonstration floors were laid which will afford a service test of southern gums, sycamore, pecan, maple, and other species. One extensive series of tests dealt with the relative suitability of 12 of the southern species as material for butter containers, with respect to their freedom from taste and odor. Ash (already recognized as high in acceptability), soft maple, hackberry, sycamore, and beech graded above yellow poplar, the species now most commonly used for butter boxes.

One study concerned the use of red oak for beer barrels. Red oaks are abundant in both southern and northern stands, but for many if not most industrial uses the trade preference is for white oak. Nowhere are requirements more stringent than in the beer-cooperage industry. With the coming of repeal of the eighteenth amendment it was felt that the heavy demands already made on decreasing white-oak resources called for some shifting of the burden. Because of its porosity, red oak allows free movement and escape of gases and liquids lengthwise through the wood. After trying various means of plugging the pores it was found that ordinary brewers' pitch could be made to serve the purpose satisfactorily, and simple means were devised for treating the interior of the barrel with the hot pitch under pressure. By this process red oak barrels were made fully as tight as those of white oak. Commercial interest in the new process is widespread.

Laboratory investigations also demonstrated that with proper equipment and drying schedules, stave material can be quickly and satisfactorily kiln-dried. At the time of prohibition repeal the time-honored air-dried stock was largely unobtainable. The experiments were made with southern red and white oak. Numerous cooperage concerns took up the new method, and a large market,

which for some months was strongly inclined toward the substitution of metal containers, was held for wood.

Investigations aimed at bringing timber utilization and naval stores production into a better relationship in the slash-longleaf pine region proceeded with a study of profitable cutting sizes for pulpwood from worked-out trees. Also, improved details of pine rosin barrel construction were developed, and time and cost studies were made in the manufacture of wooden rosin cups of different types.

A circular was prepared for publication on the production of dimension stock from the second-growth hardwoods of the Northeast. Data on the properties of western white fir and their relation to uses of the wood, prepared by the Forest Products Laboratory in cooperation with the California Forest Experiment Station, were published as a technical bulletin. A report of selective-logging studies conducted on four large band-mill lumbering operations in shortleaf and loblolly pine forests of the Gulf States was also published in bulletin form. The experience gained through study of selective logging problems in many timber types and regions proved helpful in conferences leading up to the inclusion of partial-cutting requirements in the national lumber code. The several published findings now available from the studies offer additional assistance to the lumber industry and public agencies in setting up regional logging standards.

WOOD IN THE BUILDING FIELD

The needs of the American public for adequate and economical building and housing create a large field for research in connection with the use of wood as a material of construction. One objective is to develop a strong and serviceable dwelling house of prefabricated-unit construction. Toward this end, special attention was given to the use of plywood. A strong and light floor panel was developed, in which plywood sheets are glued to the top and bottom of several joists. The relatively thick top sheet serves as a subfloor, and the thinner bottom sheet forms the ceiling for the story below. Attachment by gluing instead of nailing adds largely to bending strength, so that for spans common in house construction the required strength and stiffness can be obtained with 6-inch joist instead of the usual 10-inch, saving 40 percent in timber and thickness of the floor system. A considerable saving of time in laying the floor is also made.

The wide recognition of plywood as a coming material for interior and exterior wall covering prompted a series of full-scale wall-unit tests. A type of panel was designed for economical fabrication and tight jointing in the structure, and a number of units were built with different modes of attachment of the plywood to the studding. Lengthwise shearing tests demonstrated that the plywood wall had greater strength and rigidity than sheathed construction, and also disclosed the importance of adequate fastening by good nailing and gluing to obtain full benefit of the strength of the plywood sheet. Many small plywood specimens were tested to supply data for establishing fundamental design principles for the material.

Further tests were made in the interest of better knowledge and use of the newer forms of heavy-timber construction. The strength of joints made with plate and ring connectors was studied under many variations, to supply all the minor details required by the practical designer. This work supplements the general survey of safe loads for the new connectors which the laboratory previously conducted in cooperation with the National Committee on Wood Utilization. The earlier studies have contributed to the increasing use of plate and ring connectors in general construction. The Forest Service aided this development by offering to accept bids for fire look-out towers to be constructed either of steel or of timber, and contracts were let for 8 wood towers, 7 of them 100 feet high, to be built in the South, in California, and in the Lake States. The designs, which were prepared by the National Lumber Manufacturer's Association and inspected and approved by the laboratory, illustrate the advantages inherent in the use of modern connectors, namely, prefabrication of parts at the mill, complete pretreatment of the framed members with preservative, easy erection on the site, and dependable strength properties combined with permanence.

Strength data for glued timber arches were supplemented by time-loading tests, indicating that the laminated arch comes to final bearing position under

safe loads in a shorter time and with less deflection than a solid arch of the same dimensions. Test data on the resistance of woods to lateral withdrawal of nails and screws and to direct withdrawal of drift pins were amplified and correlated for engineering use. Certain parts of the wood handbook manuscript were redrafted in consultation with architects, engineers, and lumber producers and users, and the whole should be ready for publication at an early date.

A simplification of the Laboratory's previous recommendations for the more efficient and economical design of bridge stringers and similar wood members subject to shear was published, and the principles set forth now stand generally accepted and adopted by the engineering profession. A guide to the grading of structural timbers was published in furtherance of the long-time objective of establishing timber grades on the effective basis of strength rather than arbitrary defect allowances.

Salt-seasoning methods were applied to Douglas fir timbers 6 by 12 inches in cross section, with phenomenal results. The time required to reduce the moisture content from 62 to 20 percent was shortened from the 60 days required in ordinary kiln practice to 8 days, and checking was reduced from the 1½-inch to 2-inch depth commonly occurring to a mere surface effect not exceeding one-eighth inch in depth. The experiments are now being extended to timbers of larger sizes and to other species.

Investigations of lumber storage demonstrated a very economical method of heating closed sheds sufficiently to control humidity and to hold stock at a low moisture content.

Progress was made in research on various treatments of wood to improve its properties as a material of construction and use. A method of modifying linseed oil which promises to make paint films tougher and more adhesive was developed. Much work was done on the impregnation and coating of wood with fire retardants, and new information was obtained as to the degree of protection afforded by different chemicals. One of the facts brought out by the tests was that not only can risk of ignition be reduced by proper chemical treatment but a much larger input of heat can be tolerated before the treated wood is destroyed. Service tests of fence posts treated with a newly devised solution of tetrachlor-phenol in waste crank-case oil were begun, which may open the way to large savings in cost of preservation of wood for farm use. Technical consultation was had with officials of the Alaska Railroad in the project of establishing a tie- and timber-treating plant near the town of Anchorage. A bulletin was prepared for publication defining and analyzing the various factors involved in impregnation treatments of wood and showing how impregnation with different preservatives can be most efficiently done. This bulletin summarizes work that has been carried on over a number of years with increasing industrial recognition.

PULP, PAPER, AND CHEMICAL PRODUCTS

Research should and will lead to the conversion of more of the forest crop into refined products. A cord of wood will provide more jobs, higher wages, more tax revenue, and greater opportunities for capital investment if converted into paper or alcohol, plastics, and other chemical products, than into lumber, railway ties, and the like. While American paper-manufacturing practice, neglecting difficult native species, looks to a huge and mounting bulk of imported pulp and pulpwood to supply home needs, millions of cords of our own woods are wasted in logging, cut-over lands lie unproductive, and employment equivalent to 70,000 full-time jobs is "exported" to supply us with foreign raw material. The Forest Products Laboratory work in this field has for its broad aim larger, cheaper, more diversified, and more beneficial production of pulp and chemical products from American woods. Opportunities for modernizing and enlarging the technical plant arose during the year that made possible a better follow up of results through closer control of machinery and larger and more uniform samples, and facilitated advance in research problems.

Progress toward minimizing the pollution of streams through the discharge of waste sulphite-pulping liquors while extending the technical advantages of sulphite pulping to a wider range of wood species was made by developing a recovery system for chemicals in the soda-base process that eliminates the troublesome thiosulphates. Several digestions with liquor prepared by the

new system have proved entirely successful, and application for a nonroyalty patent on the method has been made. It is believed that the cost of operation would not exceed present recovery costs in the alkaline-pulping processes. Study of the effects of varying sulphur dioxide concentration in soda-base sulphite pulping revealed that at a low concentration the screenings from the pulp were less and the bleach requirement was slightly lower than in pulping with the customary lime-base liquors of equivalent composition.

In further studies of alkaline pulping of Douglas fir, it was found possible to cook the wood to normal pulp yields with concentrations of chemical much lower than those now used, by holding the strength of the chemical liquor unfinished throughout the cooking period. The bleach requirement of the resulting pulp is lower, and the unbleached pulp is, in general, brighter in color than commercial pulps of the same grade; the pulp is strong enough for use in high-grade papers; and it is exceptionally high in alpha-cellulose—a quality suggesting its possible utilization in rayon.

Significant progress was made in the production of newsprint from southern pines. Public interest in the manufacturing possibilities of southern pine newsprint has been greatly increased by the work of C. H. Herty, who has developed newsprint from young slash pine free of heartwood, using the standard sulphite and ground-wood processes. The Laboratory's method combines ground wood from heart-free pine with strong semibleached or unbleached sulphate pulp from pine containing the normal proportion of heartwood. The strength and color of this paper compares satisfactorily with average commercial newsprint, its raw material corresponds more closely to the natural growth of pine stands than does heart-free wood, and its production would fit more easily into the operations of pine sulphate mills now existing.

In the investigation of ground-wood production from western hemlock, the cause of the dark color frequently characterizing the pulp was traced to a dyestuff of the same kind as that identified last year in southern pine, presumably arising from tannin. In hemlock this material was found largely localized as reddish-brown granules in the ray cells. While the dye can be bleached with fair success by reducing agents, its peculiar concentration suggests that its removal may be possible by mechanical separation. The chemistry of the material is also under investigation to determine any other effective means of color removal, the finding of which would profoundly influence the utilization of many American woods.

Substantial progress was made in the investigation of the strength properties of fiber board, looking to the more efficient design of fiber shipping containers, which represent one of the greatest quantity uses of wood pulp.

In the development of sawdust plastics, specimens were produced that are as strong as softwood, free from corrosive material, and capable of being molded satisfactorily in the polished dies used by manufacturers. The new material represents a considerable technical advance, and an application for nonroyalty patent on the process is pending.

The development of the full possibilities of wood use is bound up with more fundamental knowledge of the composition and formation of the material itself. In this complex field of research definite progress was made. Three lines of investigation of the chemical properties of lignin were followed up. Refinements in method made possible the isolation of lignin free of tannins and other extractives. Viscosity measurements indicated a spherical form of the lignin molecule, and an examination of methoxyl and hydroxyl groups present in the material added significant outlines of its chemical nature. Holocellulose, the subdivision of wood substance containing the fibrous and carbohydrate constituents, was more definitely characterized, and its relationships with standard Cross and Bevan cellulose were determined. An intensive phytochemical survey of the phloem of slash pine was practically completed, through which a new view of oleoresin formation has been gained. Evidence was obtained that oleoresin exists in the active tissues of the tree in the form of a water-soluble glucoside, in which form it is translocated to the point of effusion. A systematic survey of the terpenes resulted in a new classification of these bodies based on a biogenetic theory of their origin.

In addition to the publications already mentioned, manuscripts of the naval stores handbook, revised tables of the mechanical properties of American woods, and a method of determining container hazards during transportation were prepared. A technical bulletin on the structure of compression wood as related to its properties and a handbook on the selection of lumber for farm and home are nearing completion.

RANGE INVESTIGATIONS

Range-research facilities were taxed to the utmost during the year in supplying information for the emergency programs, through supervision, inspection, demonstration, and written instructions. The C. C. C. and other agencies utilized the results of artificial-reseeding research extensively in planting depleted range lands for range improvement and erosion control. Several hundred tests throughout the West had shown which cultivated plants were adapted to dry western range lands; and more recently, desirable native species from all parts of the West have been tested at the Intermountain Forest and Range Experiment Station in central Utah.

Six wheatgrasses were found to be outstanding, with violet wheatgrass exceptionally well adapted for range sowings above 7,100 feet. Large mountain brome displayed similar adaptability; two other brome-grasses also gave good results. On the other hand, most fescues, bluegrasses, and needlegrasses were unsatisfactory. Only 7 of the 33 weeds tested demonstrated satisfactory utility. Pentstemon, yarrow, and sweet sage are readily established and are especially valuable in erosion control because they bind the soil by their network of rootstocks. Shrubs proved unimportant either for seeding or planting except along stream banks that are cutting.

Knowledge of this kind served to guide the emergency reseeding work not only in respect to what to plant and what to avoid but also in respect to the methods to use. More than 30,000 acres of seriously depleted lands were sown to various cultivated plants, and 10,000 acres were planted to the most promising native species, generally on the drier sites.

A 9-year study of grazing capacity and time of use on sagebrush-wheatgrass range in southern Idaho has shown the importance of conservative grazing on that type of range, and of permitting the principal forage plants to make reasonable growth before close grazing is permitted. This study was conducted by the Intermountain Forest and Range Experiment Station in cooperation with the Bureau of Animal Industry. A close relationship was shown between the total annual rainfall and range-forage production. The latter was measured in terms of the number of sheep-days required to utilize the feed fully. The 9-year average in a representative 80-acre paddock was approximately 5,200 sheep-days, but with a wide variation of from about 4,000 sheep-days in the driest year to nearly 8,500 sheep-days in the wettest.

When this range type, in reasonably good condition, was stocked at 1.1 acres per head per month during the spring and fall seasons, adequate feed for the sheep was supplied, and sustained production in all but the two drier years was assured; but when it was stocked at 1 acre per head per month which is lighter use than much of the spring-fall range in that section now receives, feed shortage resulted in 5 of the 9 years. One area grazed heavily in the fall as well as from the time of available forage in early spring produced 35 percent less forage in 1932 than in 1924. Palatable weeds and grasses decreased 75 percent, while sagebrush, which is practically worthless, increased 73 percent. On the other hand, a paddock grazed moderately to lightly in the spring after grasses reached a height of 6 inches, and grazed again quite full in the fall, maintained forage production. Studies are now being made to determine how heavily range may be grazed from early spring without damaging forage production.

The Sierra foothills adjoining the San Joaquin Valley in central California present a serious problem of range use and watershed protection. As fall, winter, and spring ranges they constitute the natural connecting link between the high summer ranges in the mountains and the supplemental feed lots in the valleys, but drought, overgrazing, and fire have depleted the forage stand and caused serious acceleration of erosion. While a few scattered ungrazed areas have been found which still support a good stand of perennial grasses and weeds, most of the vegetative cover is now made up chiefly of short-lived annual plants, mainly grasses and weeds of low value, or even injurious. In the higher foothills dense stands of brush have developed, which the stockmen have tried to open by burning; but the fires have reduced soil fertility, have thickened the brush, and have pushed the timber-producing belt back several miles. Growth conditions in the foothills are critical over most of the area. Of the 13½-inch annual precipitation, 12 inches falls in the months from November to April, when the temperature is at first usually too low to permit more than an inch or two of growth; and even that is ordinarily cropped closely. Warm weather in March facilitates rapid growth of the annuals, but they are virtually dried up by mid-June. To facilitate the solution of the many

important foothill-range problems, the San Joaquin Experimental Range was established during the year. It offers close contact with the livestock industry, correlation with national-forest management, and cooperation with the erosion-stream-flow studies of the California station.

EXPENDITURES AND RECEIPTS

The expenditures during the fiscal year were as follows:

General administration.....		\$528,426.31
Administration, protection, improvement, reforestation, and extension of national forests:		
Operating expenditures:		
Timber use.....	\$430,419.61	
Grazing use.....	570,991.67	
Recreation and land use.....	238,150.49	
Fish and game protection.....	109,982.39	
Classification, settlement, and claims.....	64,631.57	
Maintenance of truck and horse trails.....	1,674,880.77	
Maintenance of other improvements.....	916,028.54	
Subtotal.....		\$4,005,085.04
Protection expenditures:		
Fire prevention and detection.....	1,882,616.08	
Fire suppression.....	567,730.98	
Class total (fire).....	2,450,347.06	
Protection against insects and tree diseases.....	328,263.04	
Subtotal.....		2,778,610.10
Investment expenditures:		
Construction of truck and horse trails.....	18,490,252.11	
Construction of other improvements.....	9,413,514.69	
Equipment and stores.....	8,902,334.30	
Timber surveys and plans.....	234,356.89	
Grazing surveys and plans.....	97,591.88	
Fish and game surveys and plans.....	24,364.91	
Recreational use surveys and plans.....	64,889.79	
General surveys and maps.....	266,289.61	
Timber stand improvement.....	2,235,444.97	
Reforestation of denuded areas.....	549,534.33	
Nurseries and planting stock.....	136,064.70	
Acquisition of land by direct purchase.....	2,742,611.42	
Acquisition of land by exchange.....	154,867.13	
Nonstructural improvements (erosion, tree disease and insect control, fire hazard reduction, and miscellaneous investments not otherwise classified)....	3,354,227.34	
Subtotal.....		46,566,344.07
Construction and maintenance of forest highways:		
Construction of forest highways.....	13,669,791.30	
Maintenance of forest highways.....	984,505.43	
Subtotal.....		14,654,296.73
Total, national forests.....		68,004,335.94
Research:		
Research current expenditures:		
Forest management.....	613,954.03	
Range investigations.....	124,521.37	
Forest products.....	709,176.05	
Forest survey.....	199,247.62	
Forest economics.....	74,798.29	
Erosion and streamflow.....	104,292.24	
Forest taxation and insurance.....	28,838.26	
Maintenance of roads and trails.....	7,814.94	
Maintenance of other improvements.....	35,793.42	
Subtotal.....		1,898,436.22
Research investments:		
Construction of roads and trails.....	25,248.69	
Construction of other improvements.....	363,277.42	
Equipment and stores.....	181,020.10	
Timber surveys and plans, experimental areas.....	1,838.54	
General surveys and maps, experimental areas.....	4,267.30	
Timber stand improvement, experimental areas.....	6,442.37	
Reforestation of denuded areas, experimental areas.....	15,808.13	
Acquisition of land by direct purchase.....	28,242.22	
Nonstructural improvements on experimental areas (erosion, tree disease and insect control, fire hazard reduction, and miscellaneous investments not otherwise classified).....	35,392.79	
Subtotal.....		661,537.56
Total.....		2,559,973.78

Protection and reforestation of other than national-forest lands:

Tree planting in cooperation with States.....	\$58,782.73
Fire protection in cooperation with States.....	1,800,833.92
Protection of Oregon and California grant lands.....	56,332.59
Extension of forestry practice on State and private lands.....	126,547.95

Total..... \$2,042,497.

Miscellaneous:

Emergency unemployment relief; general planning and direction of emergency conservation work.....	1,049,104.25
Emergency unemployment relief; civil works administration.....	941,214.74
Tennessee Valley authority; emergency conservation work.....	400,205.40
Insular forests, Puerto Rico; emergency conservation work.....	138,138.95
Examination and administration of power sites for Federal Power Commission.....	15,085.01
Miscellaneous cooperation with other departments, bureaus, and individuals.....	305,687.97

Total..... 2,849,436.32

Grand total..... 75,984,669.32

The following statement shows the gross and net cash receipts from the national forests:

Gross receipts:

From the use of timber.....	\$1,522,356.19
From the use of forage.....	1,358,688.01
From special land uses, water power, and miscellaneous receipts.....	433,647.14

Total..... \$3,314,691.34

Amounts paid to States:

To Arizona and New Mexico (account school lands administered by the Forest Service).....	23,242.59
To States in which national forests are located (act of May 23, 1908).....	822,862.19

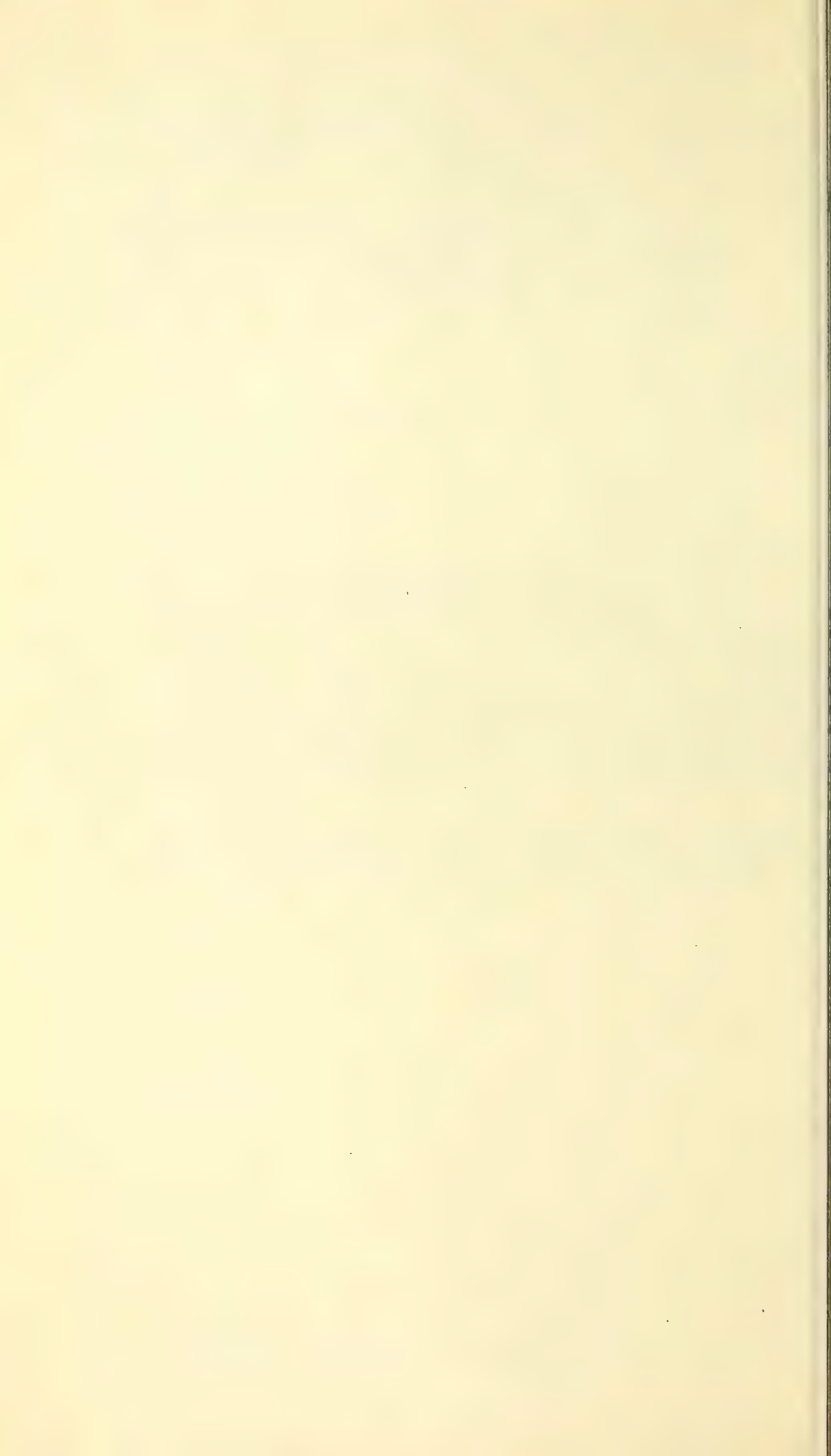
Total to States..... 846,104.78

Net total receipts to United States Treasury..... 2,468,586.56

The total of the gross receipts is greater by \$688,642.20 than that for the previous year. Receipts from timber increased \$739,547.86, grazing receipts decreased \$139,520.81, and miscellaneous receipts increased \$88,615.15.

In addition to the cash receipts from timber there should be credited the value of the timber cut under specific agreements for effecting land exchanges estimated at \$212,322.00.

¹ In addition to the expenditure for acquisition of land by exchange, national-forest timber having an estimated value of \$212,322 was cut under agreements involving the acquisition of land and timber through exchange. The cash expenditures recorded opposite "Acquisition of land by exchange" cover merely the outlay incidental to examining lands offered for exchange and appraising the value involved.



REPORT OF THE CHIEF OF THE FOREST SERVICE, 1935

UNITED STATES DEPARTMENT OF AGRICULTURE,

FOREST SERVICE,

Washington, D. C., August 31, 1935.

HON. HENRY A. WALLACE,

Secretary of Agriculture.

DEAR MR. SECRETARY: I transmit herewith the report of the Forest Service for the fiscal year ended June 30, 1935.

Sincerely yours,

F. A. SILCOX, *Chief.*

THE QUESTION OF FOREST OWNERSHIP

History affords no case of a recognized land-use problem like that now to be fore in the United States. Civilizations have waxed and waned with their material resources; dwindling means of livelihood have set rolling great tidal waves of migration and have been a prolific cause of domestic disorder, class uprising, and international war; but never before have the people of a great country still rich in the foundations of prosperity sought to forestall future disaster by applying a national policy of conservation—of which planned land use is the central core.

In that policy forest-land use rightfully has a conspicuous place. It has, in fact, had the leading place in defining the issues and presenting them in concrete terms for the public mind to grasp. For conservation as a question of national policy was born in the struggle to attain a sound policy of forestry.

Forest conservation has always had in view as its *raison d'être* human and national needs. It has looked upon forest care as a social tool, not as an end in itself. It has raised the question, in a particular field, of a planned and governed economic course designed to safeguard permanently one of the greatest of our basic resources so that we might through it promote diffused prosperity; stabilize industries, communities, and homes; further economic independence for the small man; and improve the general social and economic welfare. It stood against concentrated private control of the sources of wealth, the economic structure, and the course of government.

From the beginning, too, forest conservation has been intertwined with various phases of the national agricultural policy. The two must always mingle; they deal with the single problem of the most beneficial adjustment of human use, from the standpoint of long-range prosperity and happiness of the great body of American citizens, to the land and water resources available for or affected by tillage, pasturage, and forest practices. Forestry continues to concern primarily human values; continues to exemplify the imperative need for conservation policies to guide land use along lines that will best serve human needs; continues bound in with the readjustments essential for a sound agriculture.

Not until the nineteenth century drew near its close and the frontier neared its vanishing point did the people of the United States begin to see that the land-use policy which had been in effect up to that time called for any amendment. This land policy had a definite social as well as an economic purpose; it gave apparent preference to the small man and sought to build up a democratic citizenry of freeholders. At the same time, it assumed that the self-interest of private owners would bring all land that had any economic possibilities to its best form of use. Accordingly the aim was to hasten disposal of

the public domain. And once the individual owner had acquired title to his little parcel of the public domain, the motive of private gain was confidently expected to assure, in the long run, efficient and permanent land use. But the actual result in the commercially valuable timberlands of much of the South and the Lake States pineries, and the far Western States was far different.

By various devices and by sheer force of circumstances, the intent of the laws designed to convey the public-domain timberlands in small tracts to individuals desiring them for personal and permanent use was frustrated on a gigantic scale. Actually, a man or woman who had entered a timber or stone or homestead claim on land chiefly valuable for its virgin forest could ordinarily cash in on his acquisition only by selling it for consolidation into a much larger holding. Actually, too, the inducement leading to private acquisition of public-domain timberlands was not the prospect of profiting by putting the land itself to use, but the value of the grown timber for exploitation. Hence a strong trend toward a purely temporary occupancy. If after the merchantable timber was cut and removed the land could not be sold, all that was necessary was to stop paying taxes and let it go back, skinned of its value, to public ownership.

So the original policy of land disposal did not meet its social objective. It operated, instead, to create a highly transitory lumber industry; one eventually beckoned on to new fields of cheap and abundant virgin timber when its earlier sources of supply began to give out. And it served to stimulate private acquisition of the commercially valuable forests of the public domain, not for any purpose of permanent land use but purely for profit in removing the timber.

Much too late for the best interests of the country, the process of forest disposal eventually began to be checked. Slowly at first, then rapidly for a few years, the still remaining public-domain timberlands were drawn upon to build up the western national-forest system. With considerable readjustment of the western national forests now embrace a smaller total area than in 1911. For restrictions of various kinds have hampered their extension and prevented carrying through, entirely, that policy of permanent public administration of forest lands of the public domain which was to have replaced the earlier policy of alienation. Nevertheless, the great bulk of so much of these lands as has not been passed into private possession before the national forests were successively proclaimed—chiefly by President Theodore Roosevelt—is now included in the public-forest system. But the cream of the western forests—the most valuable stands occupying as a rule the land where timber grows best—was first skimmed for private ownership; the national forests are, by comparison, but culls and residues.

The outcome of all this is a forest situation of which the major outlines can be succinctly sketched. With a total forest-land area of approximately 6 million acres (nearly one-third the land surface of the continental United States) 435 million are in private ownership and 180 million publicly owned. Of this publicly owned forest land, 140 million acres, in round numbers, is under some form of more or less permanent public administration with a view to conserving its usefulness. National forests include 63 percent of it. Nineteen twentieths of their area (which includes considerable nonforest land) came from public-domain reservations; the other twentieth has been acquired through purchase or exchange, chiefly from private owners though in small part from States. As a rule, these areas have been acquired after lumbering by private timberland owners has greatly depleted—if not butchered—the forest.

Many million acres of forest land formerly in private ownership have drifted or are drifting back into the hands of the public through tax forfeiture to States or counties. This is mostly cut-over or burned-over land in too poor a promising a condition to seem worth holding longer as private property. The still more extensive abandonment in prospect is unquestionable. In showing impermanency as a characteristic of much of our private forest-land ownership and of the contribution made by that land toward community life, is widely evidenced. But the heart and soul of conservation is a system of land use that will sustain permanent communities and give a comfortable livelihood to the largest possible number of citizens. Public policies of forestry have gone far toward working out this forest-conservation problem on lands definitely owned by the public. The great unanswered question now concerns the future of forest lands in private ownership, and those drifting between public and private ownership through tax delinquency. Ownership of these lands, and use of such resources as they now or may hereafter contain, are extensively unstable. The diminished requirements for agricultural land and the increasing area

farm lands that have become or are becoming submarginal through soil erosion loss of fertility from other causes augment the problem.

Of the 435 million acres of privately owned forest land, 150 million acres are in farm woodlands. This part of the problem is relatively simple. Except where the necessity for agricultural readjustments makes farming itself unstable, farm woodland is integrated in permanent farm units, with a relatively high degree of stability of ownership. The chief need is to make available the same kind of knowledge about handling this part of the farm as is extended regarding other farm production—knowledge of where and how to grow the wood crop or establish the shelterbelt, and how best to harvest the crop and market it at the farmer does not require for himself. Beyond that, of course, is the need in many regions to give farm holdings the benefit of organized public systems of protection against the spread of forest fires. Both these things are essential, for farm woodlands are too commonly deteriorating. Where treated actually as wild lands, their full potentialities as sources of increased farm homes and of forest products, especially of high-quality timber for general assumption, are lamentably unrealized. The farm-forestry problem is then one aspect of the general problem of agriculture in our national economy. It involves public aid to the farmer to enable him to use his land to his own greatest advantage and that of the Nation.

The nonfarm privately owned forest land includes some 45 million acres of noncommercial and 270 million acres of so-called "industrial" forest land. The first is land which, unable to grow tree crops good enough in quality and quantity to be commercially operable under existing or reasonably foreseeable conditions, is consequently under private ownership for some other use, such as pasturage. Here the primary question is whether there are involved such watershed or recreation and wildlife values as may necessitate public ownership. This question also is a relatively simple one. It calls merely for a determination of the facts in individual cases. But for the great area of nonfarm privately owned land suitable for commercial timber growing and now the chief support of the forest industries—amongst which the lumber industry holds the leading place both in value of output and as an employer of labor—the problem is much more complex.

This so-called "industrial" forest land is in large part owned by the industries which convert its supplies of raw material into manufactured products; most of the rest is owned by individuals or companies that expect to sell to those industries. Only an insignificant fraction of the total area of industrial forest land is being handled for sustained yields of forest products. True, the Lumber Code required utilization practices that would keep the land from becoming wholly unproductive; and this was a great gain over the destructive methods previously in general use. And though the code has been declared unconstitutional, a considerable effort is being made to obtain voluntary observance of its restrictions upon those common practices that produce forest devastation. From a conservation standpoint, the Lumber Code's achievement was educational; it made the great body of timber operators aware for the first time of those woods practices requisite to maintain forest lands in a productive condition. The forest industries need, and should have, reasonable public aid toward transforming themselves from transitory industries based on forest exploitation to permanent industries operating on what the forest annually grows and can continue to grow. But the fact must be faced that industrial stabilization resting on stabilized utilization of privately owned forest land is still a long way off.

Stabilized forest-land utilization presupposes stabilized ownership. No private owner will undertake to apply forest management on land which he does not expect either to keep as an investment in timber growing or to sell to some one else as valuable for the same purpose. A great deal of the present industrial forest-land ownership is bound to remain unstable as private property. The forest depletion and forest abuse have been carried, the more this holds good. We must face the fact that the prospect of making this land income producing as a permanent timber-growing enterprise is too uncertain and the time when paying returns can be looked for is too remote to make holding and managing it seem good business. Admittedly there is no future for a large part of the industrial forest-land acreage as private property. The pronounced movement toward abandoning it to involuntary public ownership is an impressive indication of this fact. That an extensive policy of public purchase will be adopted as a means of enabling tired carriers of unwanted industrial forest lands to lighten their burden is a prevalent hope among private owners. This

desire to unload is not limited to owners of timberlands that already have been heavily lumbered. An extensive taking back into public ownership of virgin stumpage on lands originally acquired from the public domain under false hope of its reasonably early marketability is also strongly favored by many private owners.

One of the objectives of public forest policy should plainly be to counteract through appropriate measures, the forces that are making private ownership unstable. The gravitation of surplus or timber-depleted industrial holdings into the hands of public authorities is, within limits, a corrective process. Private ownership has been overextended and is unable to carry permanently all the load it has optimistically taken on, usually with no intention of carrying it permanently. But the productive timberland of the country affords, and should always afford, a very large field for private enterprise in holding and managing a great part of it. One of the things necessary to promote this is bringing about a due balance between public and private ownership. A well-conceived large-scale extension of public ownership will reduce the dimensions of the problem created by the past overexpansion of private timber acquisition, and is an essential part of any program for stabilizing ownership, forest use, and the forest industries.

Ever since its inauguration in 1911 the Federal policy of buying lands for national forests has, with insignificant exceptions, been applied to lands having on them very little, if any, merchantable timber. With exceedingly limited purchase funds available in comparison with the great acreage of land urgently needed in public ownership to attain the public ends desired, no other course was practicable. With markedly larger sums available, there has been inaugurated during the past year a definite modification of this former course; a start made toward purchases that permit the practice of forestry immediately as a going enterprise. The thought has been expressed that this is an unsound policy; that to remain noncompetitive with industry Federal purchases of forest lands ought to be limited to land with values so low that no private owner will want it.

This would mean that offers to the Government of timber stands which are suitable either for ruthless exploitation or for a forest-management enterprise should be declined, even though the major likelihood is that a private purchaser will exploit the land instead of putting it under permanent forest management. It is true that reasonable public encouragement of and assistance to private forestry should be offered, but it is equally true that the public course must be governed by what will most advance the public welfare. To wait always until the forest has been so wrecked that only the public purse can possibly meet the expense of reclaiming it, or to limit public forestry to lands too poor to make timber production cover its cost, would mean that the true objective of public-forest policy had been lost sight of. For that policy must place first the need of the people of the United States for efficient land use as a means of gainful employment and stabilized and permanent prosperity. The essential point is that unless public acquisition is stabilized, programmed, and pressed forward on broad lines with all possible speed, the potential capacity of the forests of the country to provide work for a large dependent population and to furnish raw materials for industry and commerce will inevitably diminish instead of being built up.

COOPERATION UNDER ARTICLE X OF THE LUMBER CODE

One of the expressed purposes of the National Industrial Recovery Act was to conserve natural resources. The Lumber Code, in furtherance of this objective, contained an obligation on the part of lumbermen to apply such practicable forestry measures in connection with timber cutting as would be necessary to keep their timberlands continuously productive. This obligation was covered by article X (conservation) of the code.

The code was administered by the organized industry, with the national and regional trade associations serving as the code agencies. Lumbermen constituted the administrative committees having the forestry work in charge, and these committees employed technical foresters to supervise the field work.

The public interest involved in the proper management of privately owned forests led the Forest Service to cooperate actively in the code forestry project. The knowledge and experience of our research and administrative personnel throughout the United States were made available to the industry. Assistance was given in the drafting of the general principles to govern the undertaking.

and in the formulation of the detailed regional rules of practice to be followed on the ground. Field studies were conducted with the object of strengthening the rules and simplifying their application, and educational and demonstrational work was carried on among the operators.

The code forestry requirements became effective June 1, 1934, and terminated when all codes were abolished on May 27, 1935—a period of about 1 year.

The results obtained under the code in terms of actual improved forestry practices in the woods were apparently not great. The project involved the establishment of a new point of view as well as new methods in dealing with the management of a vast majority of the 30,000 or more operations throughout the United States. Little impression could be made in the short period during which the forestry requirements were in effect.

The chief contributions of article X to forest conservation were educational in character. The code forestry work produced a clearer understanding throughout the industry of the importance and technic of sustained-yield management designed to promote community and industrial stability. It supplied information on the benefits to be derived from selective logging, and gave instructions on the character of the protective and silvicultural measures required to keep a forest continuously productive. The participation by the lumbermen in the active direction of the forestry work was a very important factor in achieving this desirable result in forest education.

RESETTLEMENT PLANNING ON THE NATIONAL FORESTS

During the year detailed economic and population studies were completed for over 40 possible resettlement projects. The units studied are 100,000 to 500,000 acres in size, including national-forest and adjoining lands, each unit constituting with its lands, industries, villages, farms, educational institutions, etc., a community of economic and social interest.

The objective was to determine the need for and feasibility of resettlement and rehabilitation projects on the national forests. For the areas covered, a need is indicated for: (1) The resettlement of families on submarginal farms and in decadent industrial towns; (2) opportunities for table gardening and part-time farming for seasonal and part-time employees of the Forest Service and of lumbering and other industries in and adjacent to the national forests; (3) employment opportunities for families now barely subsisting on farms too small to yield a full living, or stranded in towns and villages by the exhaustion of private timber resources, the closing down of mines, etc.; and (4) employment opportunities for workers temporarily dependent upon public relief because of the economic depression.

The need for resettlement of families now on submarginal farms includes such considerations as the following: (1) Most of the submarginal farms within the forest units are best suited and needed for national-forest purposes; many owners of such lands will not sell until offered opportunities for resettlement on good land; many others would sell at more reasonable prices if such opportunities were available; (2) occupants of isolated submarginal farms within the forests often cause a serious fire risk; (3) their presence often prevents the best development of recreation and wildlife resources; (4) the cultivation of steep submarginal lands results in erosion and defeats the objectives of watershed protection, for which many of the forests were established.

Three classes of feasibility are encountered: (1) Where reasonably assured employment and good agricultural land are available to make resettlement feasible without further assurance of funds for public works programs or additional employment opportunities; (2) where some assurance is needed that funds will be regularly available for forestry work before resettlement will be feasible; (3) where the resident population exceeds both the reasonably assured employment and the economically justifiable forestry work and hence new opportunities must be created before resettlement will be feasible and a means available for families to free themselves from continued dependence upon public relief.

It is estimated that not over 10 percent of the resettlement needs of the eastern national forests fall in the first class. About 70 percent could be solved if funds were reasonably assured for a continuing program of intensive and extensive forestry. Twenty percent of the problem could only be solved by creating new opportunities. This estimate includes only the submarginal farmers and the stranded workers once primarily dependent upon forest work, and those intermittently employed in and adjacent to national forests.

The problem in the western national forests is less acute, and quite different. It principally requires the control of "cut-out and get-out" lumbering of private forests within and adjacent to the national forests, the development of sustained-yield operations, and the provision of resettlement opportunities for part-time workers now living in transient lumbering camps and logging towns.

On June 30 the reports on the several areas were being reviewed, and those falling in the first feasibility class are to be submitted to the Resettlement Administration as work-relief projects.

These studies reemphasize the problems of overpopulation, lack of economic opportunities, and submarginal farming in the forest regions. They attempt to show the place of forestry in the economic and social reconstruction of the severely depleted cut-over areas of the eastern forest regions. Until timber resources are restored so that sustained-yield logging and lumbering can start the thinning and care of growing timber and other forest work can give useful employment to a large part of the destitute and stranded population of these regions. Until there is some assurance that funds will be regularly available for such work the bulk of the desirable resettlement on the eastern forest cannot be undertaken; nor can many of the most seriously eroding and other lands needed for forestry be acquired until the assurance of such employment makes it feasible to resettle the families now residing on such lands.

Aside from the long-time program, the needs of the resident workers of the national forests should also be recognized in any temporary program of work-relief. Accordingly, plans have been prepared for the 1936 work program which, if approved, will give employment to nearly all of the resident unemployed suitable forest workers in and adjacent to the national forests.

FOREST-LAND PLANNING, PUBLIC AND PRIVATE LANDS

A study was conducted for the National Resources Board to determine the specific areas which should be under each of the forms of management and ownership recommended in the Copeland report. Cooperating with the National Resources Board, State forestry agencies, planning boards, experiment stations, and other interested agencies, data were assembled and recommendations were prepared for a program of forest ownership and management for over 80 percent of the total forest area of the country. The recommendations were incorporated into a report, the high lights of which appeared in part II of the National Resources Board report. The detailed report is in the hands of the National Resources Committee, which plans to publish it as a part of a detailed report on land resources.

For the area covered by the study more detailed information on forest lands was collected than ever before existed. The plan of ownership and management is, of course, subject to current revision, but it provides for the first time a definite basis of understanding for the several agencies interested in and responsible for public forestry activities and the extension of public forest holdings.

The recommendations for ownership substantially support those of the Copeland report, recommending a total of 178 million acres of additions to public forest ownership. An increase of 9 million acres of forest lands in public ownership or in process of acquisition was shown to have occurred since the preparation of the Copeland report.

THE GREAT PLAINS SHELTERBELT PROJECT

During the year plans for the Great Plains Shelterbelt Project were definitely inaugurated and the exterior boundaries established. The present boundaries encompass a strip 100 miles wide, extending north from Mitchell, Nolan, Taylor and Callahan Counties in Texas through Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota to the Canadian boundary. The location of the shelterbelt was decided on only after a careful study of prevailing wind directions, wind velocities, average annual precipitation, position of the water table and the character of the soil in relation to tree growth. Within this 100-mile belt, shelterbelt strips 10 rods wide will be established 1 mile apart, so located as to intercept the prevailing winds.

The strips will not be laid out in a uniform pattern; nor will all the land within the belt be provided with them, since in many places the conditions are not suited to tree growth. It is expected that the farmers of the region will supplement the strips with intervening plantings of lesser widths, ultimately

surrounding each 40 acres with some degree of protection. In addition to the belt planting, cooperation is being extended to farmers in the establishment of windbreaks about farm buildings as a protection to human habitations and to stock.

Real progress was made in the spring of 1935 in getting the projects under way. Some work was done in all the States concerned. All together, 125 miles of shelterbelt plantings were established, 4,800 acres of farmstead planting on 1,800 farms were completed, and 552 acres of land were placed under lease for nursery purposes and seeded to the needed species. Barring extreme weather conditions, unforeseen insect infestations, or fungi infections, it is expected that about 56,000,000 seedlings will be available for next spring's planting.

THE CIVILIAN CONSERVATION CORPS

The objective of the Civilian Conservation Corps, organized under the provisions of the Emergency Conservation Work Act of March 31, 1933, has been to engage unemployed young men upon noncompetitive but constructive work in the conservation, restoration, and development of natural resources. This objective has been attained in signal degree. The man power of this veritable army has been made available to serve the needs of the several Federal agencies charged with conservation functions, and particularly the Forest Service.

The national forests, located in 37 States and in Alaska and Puerto Rico, have continuously afforded a vast work reservoir, absorbing nearly a third of the corps' average man power of 300,000 enrollees. In addition to work on these national properties, and in order to further cooperative measures authorized by Congress, the Forest Service has supervised work projects on State and private forest lands, and has operated camps assigned to the Tennessee Valley Authority. Over 70 percent of the project work of the corps has, during the most of the fiscal year, been under the planning and supervision of the Forest Service. At the close of the year, after the erosion-control camps were turned over to the Soil Conservation Service, the labor strength of 946 camps of 200 men each out of the total of 1,641 Civilian Conservation Corps camps was still under the direction of the Forest Service.

The work accomplished by the Civilian Conservation Corps (reported in detail by the Director of Emergency Conservation Work for the initial 2-year period ended Mar. 31, 1935) has been monumental. For the Forest Service as a whole this work represented the labor of 38,605,470 man-days. The projects constructed are evaluated at \$343,703,402. This work, of varied character, included principally forest-fire prevention and control through the construction of telephone lines, look-out towers, airplane landing fields, tool houses and boxes, and foot, horse, and motor-truck trails; the destruction of forest-destroying insects and fungi; improvement of the commercial value of forests by thinnings and the removal of dead, defective, and weed trees; mapping of forest types and estimates of their value; reforestation of denuded areas, including the collection of seed, establishment of nurseries, and the planting of seedlings; the construction of public camp grounds and other recreation facilities; revegetation of overgrazed lands, the elimination of rodents destructive to forage cover, the eradication of plants harmful to livestock, and the construction of wells, fences, and corrals; and the development of streams, springs, reservoirs, and ponds for fish, birds, and other wildlife.

Throughout the Civilian Conservation Corps camps an educational program of wide range is directed by the War Department, which has charge of camp administration, in cooperation with the Office of Education of the Department of the Interior. In this program special emphasis is placed upon vocational training. Many young men are particularly interested in opportunities for employment in woods work and allied conservation activities. To this end the Forest Service personnel in the camps has actively assisted the educational advisers in the work of instruction. This instruction consists of simple orientation courses to give the enrollee an appreciation of the place of forestry and conservation in the national economy; to promote the value of his citizenship; to stimulate intelligent interest in his particular Civilian Conservation Corps work project; and to guide his selection of future employment. Training in particular skills and techniques is emphasized to promote the enrollee's job efficiency, to qualify him for advancement, and to prepare him for a job as a skilled worker upon completion of his term of service with the corps.

The Civilian Conservation Corps has proved to be a singularly successful enterprise in the rehabilitation of young men and the development of natural

resources. The work accomplished for the national forests alone has greatly advanced the normal program of construction projects. The provision of Congress authorizing the extension of the operation of the corps under the Work Relief Act of April 8, 1935, and the increase of its strength to 600,000 men will nearly double the number of work projects during the current fiscal year. Provision has been made to establish a total of 2,916 camps, and the work projects of more than half of them will be under the direction of the Forest Service. Under the expanded program about 50 percent of the labor strength of these camps will be allocated to the national forests and 25 percent to State forests; the remainder will be largely allocated to private forest lands.

DEVELOPMENTS IN ORGANIZATION

The great expansion in the whole scope of national-forest work of the past 2 years has made obsolete old concepts of the functions, duties, and responsibilities of forest officers, from district rangers up to the Chief of the Forest Service. In cooperation with the Department of Agriculture, the Forest Service, early in 1935, undertook a comprehensive restudy of the entire organization structure. The duties and responsibilities of all Forest Service positions were scrutinized and redefined, and a reclassification of many field positions followed. In the Washington office the results of the organization studies have not yet been fully applied.

Early in 1935 a new plan of regular staff conferences was begun. The regional foresters, directors of the forest experiment stations, and members of the central staff meet quarterly (except in the summer) to consider questions of policy and strategy. The staff meetings are proving an important means of meeting current policy problems, keeping all units of the Forest Service in close touch with each other, and bringing to bear on the difficult questions of today the ability and range of viewpoint of the whole Forest Service.

A further new development in staff work has been the inauguration of special committees, made up of Washington staff members and regional and experiment station officers. One of these committees is now engaged in a comprehensive study of the personnel problem of the Forest Service, including recruiting methods of development through in-Service training and change of assignment, and the selection and development of men for higher leadership. It is clear that far greater attention to and formalization of personnel management, including a recognized budgetary set-up, is required than heretofore. A step in this direction has already been made in the field reorganization and reclassification through the creation of a division of personnel management in several of the regional offices.

One of the more significant conclusions from the personnel committee's study is the urgent need for a wider grounding of forest executives and leaders in economics, the social sciences, and other comparable fields. The reclassification of field positions was essentially to meet the need for Forest Service participation in land planning, attack on the whole relief problem, and other economic and social measures not always recognized as being involved in technical forestry.

LEGISLATION OF THE YEAR

The legislative record which follows includes, for convenience, all acts passed at the first session of the Seventy-fourth Congress, whether before or after the close of the fiscal year.

The acts making appropriations were:

The act of April 8, 1935 (Public Resolution 11, 74th Cong.), appropriating \$4,880,000,000 for relief purposes. From this appropriation \$12,000,000 was made available prior to the date of this report for the acquisition of lands under the Weeks law; \$15,000,000 for the protection, improvement, and extension of the national forests and for research, including \$1,991,000 for the shelterbelt project; and \$750,000,000 for the Emergency Conservation Work and associated activities.

The Agricultural Appropriation Act, fiscal year 1936 (Public, 62, 74th Cong.), approved May 17, 1935.

The following acts relating to national-forest administration were passed:

The act of April 17, 1935 (Public, 38, 74th Cong.), authorizing the Secretary of Agriculture to cancel timber-sale contracts entered into prior to June 30, 1934.

The act of March 2, 1935 (Public, 16, 74th Cong.), authorizing conveyance to the State of Mississippi for the use of its National Guard certain lands acquired for forestry purposes.

The act of August 26, 1935 (Public, 337, 74th Cong.), authorizing the appropriation of receipts from the Wasatch and Uinta National Forests, Utah, for acquiring privately owned lands in those forests.

The act of August 29, 1935 (Public, 395, 74th Cong.), authorizing the Federal Government to cooperate with the States in promoting the development of State forests. This is the so-called "Fulmer Act."

The act of May 29, 1935 (Public, 82, 74th Cong.), authorizing the disposal of abandoned improvements at Civilian Conservation Camps.

The act of June 25, 1935 (Public, 164, 74th Cong.), authorizing the acquisition by exchange of certain privately owned lands within the Lincoln National Forest, N. Mex., but reserving minerals therein to the State.

The act of August 27, 1935 (Public, 358, 74th Cong.), setting aside certain lands within the Prescott National Forest, Ariz., for recreational uses by the city of Phoenix, Ariz., under cooperative agreement with the Forest Service.

The act of June 20, 1935 (Public, 156, 74th Cong.), transferring certain lands from the Cibola National Forest to the Zuni Indian Reservation, N. Mex.

The following acts authorized additions to national forests:

The act of August 2, 1935 (Public, 227, 74th Cong.), authorizing the extension of the boundaries of the Chelan National Forest, Wash., for a distance of 4 miles from the present boundaries.

The act of June 13, 1935 (Public, 130, 74th Cong.), authorized the addition of certain lands to the Willamette National Forest, Oreg.

The act of June 13, 1935 (Public, 131, 74th Cong.), authorized the addition of certain lands to the Siskiyou National Forest, Oreg.

The act of May 24, 1935 (Public, 68, 74th Cong.), authorized the addition of certain lands to the Deschutes National Forest, Oreg.

The act of August 20, 1935 (Public, 288, 74th Cong.), added lands to the Medicine Bow National Forest, Wyo.

The act of August 26, 1935 (Public, 328, 74th Cong.), added certain lands to the Pisgah National Forest, N. C.

PROGRESS IN STATE FORESTRY LEGISLATION

Laws authorizing Federal land acquisition for national forests were passed by Maine, Rhode Island, Ohio, Indiana, Idaho, Montana, Utah, California, Oregon, and Washington, while New Hampshire, Missouri, and Arkansas extended the scope of earlier authorizations. In all, 34 States have now authorized such acquisitions, in some cases with various forms of limitations, in others without specified restrictions. Maine restricted the acquisition to certain counties, by purchase only, and made inapplicable to lands acquired under the new law the provisions of the enabling act mentioned a year ago in this report. The Idaho, Montana, and Utah laws likewise specified acquisition by purchase; Montana, however, also authorized boards of county commissioners to exchange delinquent tax lands for Government lands or standing timber of equal value. Oregon stipulated that all contemplated acquisitions must have the approval of a State board of forest conservation, created by the act and comprising the Governor, the State forester, the chairman of the State tax commission, and two appointees of the Governor chosen from the county judges in counties containing at least 400,000 acres of forest land; and also required a county-court order of approval prior to acquisition in any county. Washington authorized acquisition by either purchase or gift, but only with the approval of the State forest board, and retained a concurrent jurisdiction to tax persons and corporations and their property and transactions on the land acquired.

New Hampshire granted consent to the acquisition of lands better adapted by reason of quality, location, or condition to public conservation, forestry, recreation, or experimental or demonstrational purposes than to continued private ownership and development, if recommended by the land-use board and approved by the Governor and council. The board was established by the act, to consist of five members appointed by the Governor with the advice and consent of the council. Arkansas removed the limitation which had confined acquisition to counties wherein national forests are located, or adjoining counties, and Missouri removed the restriction prohibiting acquisition of more than 100,000 acres in any county. In addition Arkansas provided for the sale to the Federal Government of tax-forfeited lands within the boundaries of national forests.

An Idaho constitutional amendment giving the legislature power to authorize negotiation by the State Board of Land Commissioners of land-exchange agreements with the United States will be submitted to the electors at the general election in 1936. An amendment to the Minnesota constitution authorizing exchanges will be submitted to the electors at the general election in 1936. A similar amendment, mentioned in this report 2 years ago, was lost at the November 1934 general election.

Washington authorized the State forest board to issue utility bonds up to \$300,000 for purchasing private lands found through land classification to be

suitable only for growing timber, provided the purchase can be made at a satisfactory price and will enable the State to build up sizeable blocks of timbered areas. New York by concurrent resolution approved the Federal program of purchasing marginal and submarginal farm lands for reforestation and other conservation purposes. Arkansas authorized the State forestry commission with the approval of the Governor, to set apart for permanent State forest certain suitable State-owned lands, and also lands which have reverted to the State for taxes; and provided for the exchange of lands to block up areas into suitable units.

North Carolina provided for State management of federally acquired submarginal lands suitable for creating and maintaining State-controlled forest and other recreational areas; and also for holding vacant and inappropriate State lands which are suitable for national or State forests or parks. Another act protects from injury land under option by the Federal Government. Minnesota created 13 new State forests, authorized the acquisition of lands within them by gift, purchase, or condemnation, made additions to 3 existing State forests, and authorized the director of the division of forestry to purchase sites not exceeding 40 acres in area for administration and other forestry purposes; the old law limited the area to 5 acres. California authorized the director of natural resources to receive, hold, and acquire land for future development for forestry purposes and to manage these lands and dispose of the products therefrom.

County zoning, which provides for setting aside areas for purposes of trade, residence, recreation, farming, forestry, and conservation of soil and water supply, was adopted in Tennessee and Michigan. In the latter State, county boards of supervisors were given the power to regulate zoning; State, county and regional commissions are to prepare county zone maps.

In anticipation of the enactment of a law for Federal acquisition of forest land for administration by the States as State forests, Alabama, Delaware, Florida, Iowa, Louisiana, Maryland, Michigan, Minnesota, New Jersey, North Carolina, North Dakota, Rhode Island, South Carolina, and Texas passed enabling acts authorizing their respective State forestry agencies to enter into cooperative agreements with the Secretary of Agriculture for the acquisition and development of State forests. Some States were already equipped with legislation to qualify for Federal assistance under the act. New York by a concurrent resolution approved Federal land purchases for State forests. Vermont gave consent to the acquisition by the United States, by purchase or gift of certain lands necessary for the establishment, consolidation, and extension of State forests and other reservations, subject to several strict provisions in favor of the State.

Connecticut provided that any receipts resulting from management of the State forests, including the proceeds of sales of wood, timber, and other products, shall go into a forestry fund, to be expended in the protection, management and development of the forests, the preparation and marketing of forest products therefrom, and land acquisition for their extension and completion. Michigan authorized the director of conservation to dispose of timber from State lands.

Oregon increased the membership of the State board of forestry from 7 to 8, the new member to be appointed by the Governor on the recommendation of the Western Pine Association. New Hampshire changed the name of the forestry commission to forestry and recreation commission. Vermont created a department of conservation and development, to be administered by a State board of the same name, and to comprise a forest service, a fish and game service, and a publicity service. The State forest service was formerly under the department of agriculture. Iowa abolished the State board of conservation, the State fish and game commission, and the office of State forestry commissioner, and created a new agency to be known as the "State conservation commission", made up of 7 citizens of the State; the administrative head to be called "State conservation director."

Much State forest-fire legislation was revised. Oregon lengthened the closed season 15 days, making it from May 15 through October 15, and changed the requirements relating to snag felling in conjunction with timber operations in the fir belt so as to exclude Jackson and Josephine Counties and make the requirements identical with those fixed by the Lumber Code. Tracts may be examined and, if the number of snags is excessive, relief can be given. However, the operator may be required to fell a certain number of snags, and the State forester may designate the area. Another Oregon law gives the county courts authority to adjust the valuation on timberlands damaged by a fire

covering more than 10,000 acres. California authorized the division of forestry, in cooperation with the State Water Commission, to determine experimentally the effect of burning off brush and debris on run-off and water level.

Florida gave the State Board of Forestry and the Federal Government liens prior to all accruing thereafter on cooperators' lands when the fire-control assessment is not paid; authorized a referendum to determine whether or not organized fire-prevention and control work in cooperation with the State Board of Forestry shall be carried on by the counties; authorized the board of forestry to set up forest-protection districts within which permits will be required before any burning is allowed; provided penalties for allowing fires to spread to adjoining lands; and authorized the board to offer rewards for the apprehension of violators. Michigan authorized the Governor to prohibit, in time of drought or extreme fire danger, the use of fire or tobacco in the forest, and required slash disposal within a minimum of 50 feet from highway rights-of-way. West Virginia changed the rate of compensation for fighting forest fires, formerly restricted to not more than \$1 per day, to a rate per hour to be determined from time to time for each county by the director of conservation; payment to be a charge against the State instead of the county. North Carolina provided for protecting its forested area from fire with payment of one-half the cost by the county, to an amount not to exceed in any 1 year 5 mills per acre of total woodland area in the county, unless more is specifically authorized by the county commissioners to meet an emergency.

Idaho, Indiana, New Hampshire, North Carolina, North Dakota, Vermont, and Washington enacted laws making provision for reimbursement of the Federal Government for the expense of emergency conservation work if and when, by a sale of land or products, the State derives a profit from the work. Oregon passed similar legislation, and in addition provided for an appropriation of \$20,000 for the work during the next biennium. New Hampshire continued the unexpended balance of the fiscal year 1934-35 appropriation for emergency unemployment relief by forestry and general improvement work. Rhode Island provided \$10,000 for renting, leasing, or purchasing property needed in connection with the work of the Civilian Conservation Corps or to establish and maintain forest areas for such work; and Iowa appropriated \$500,000 for cooperation to further the Federal emergency conservation program, primarily through the purchase of State forests and State park lands.

South Dakota authorized entering into agreement with the United States for the improvement of State lands by the establishment and maintenance thereon of shelterbelts of trees and other plants, and North Dakota by a concurrent resolution endorsed the Federal shelterbelt project.

Oregon provided machinery for collecting currently taxes on timber removed from tax-delinquent property, to prevent the removal of the timber between March 1 of each year and the tax-payment date of the subsequent year without paying the taxes, and then letting the land revert. The State reforestation lands law was amended, principally by the elimination of the yield tax on forage; also, the annual forest fee was lowered for eastern Oregon to 4 cents per acre in place of the former State-wide 5-cent fee. Another Oregon law authorizes the State Tax Commission to correct, as of the year of the original assessment, the "erroneous assessment" on any property the amount of which is in excess either of its true value or of the prevailing ratio to true value at which other property is assessed, and if approved by the county board of equalization concerned, all taxes on property so reassessed are reduced accordingly. Wisconsin transferred the State treasurer's duties in connection with the forest crop law to the conservation commission; and enacted a law permitting the owners of farm wood lots suitably protected against grazing, or of farm lands with a gradient of 30 percent or more which the owner will make a reasonable attempt to protect from erosion by reforesting it, to obtain complete exemption of both land and timber values by applying for and obtaining classification. Michigan and Alabama liberalized their forest-tax laws in certain minor features.

Pennsylvania practically reenacted the two 1913 auxiliary forest reserve and tax acts which were declared unconstitutional in 1931, with some omissions and additions designed to conform to the points raised by the court. Revival of all contracts entered into with forest owners under the old law was authorized.

Massachusetts placed the duty of enforcing fish and game laws within State forests on the forester, the State fire warden, and members of the State police. Florida made natural resources a required subject in State educational insti-

tutions and high schools; established a department of forestry in the University of Florida; and authorized the State Board of Forestry to establish a park service, to cooperate with State and Federal agencies in acquiring, developing and administering State parks, and to cooperate with counties in park work. Minnesota provided for licensing Christmas-tree dealers and tagging Christmas trees sold within the State, and Idaho for licensing nurserymen, with a schedule of license fees.

WORK OF THE YEAR IN STATE COOPERATION

Federal appropriations for cooperative work with the States during the year as compared with those in 1934 and 1936, are shown in table 1.

TABLE 1.—*Appropriations for State cooperation, 1934-36*

Item	Amount appropriated for fiscal year—		
	1934	1935	1936
For the prevention and suppression of forest fires, and for the forest-taxation inquiry and the insurance study (secs. 1-3 of the Clarke-McNary law).....	\$1,565,635	\$1,573,619	\$1,578,619
For the distribution of forest planting stock to farmers (sec. 4 of the same law).....	56,053	56,296	56,319
For farm-forestry extension (sec. 5 of the law, administered by the Division of Cooperative Extension).....	50,240	51,354	56,819

¹ The item of the appropriation act was \$1,537,513. The initial administrative cut was \$393,878, of which \$375,000 was later restored.

² Made up as follows: \$1,348,619 from the Agricultural Appropriation Act of Mar. 23, 1934, and \$225,000 from the Deficiency Appropriation Act of June 19, 1934.

³ The item of the appropriation act was \$74,736. The administrative cut was \$18,683.

⁴ The item of the appropriation act was \$64,787. The administrative cut was \$14,547.

Table 2 shows in detail Federal, State, and private funds disbursed by the States or expended under their supervision for the prevention and suppression of forest fires, and the Federal and State funds disbursed by the States for the production and distribution of trees for "windbreaks, shelterbelts, and farm woodlots."

TABLE 2.—*Cooperative expenditures for fire protection and for the distribution of forest-planting stock under the Clarke-McNary Act, fiscal year 1935*

State	For fire protection				For the distribution of forest planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Alabama.....	\$35,000.00	\$13,467.25	\$24,398.38	\$72,775.63	\$673.04	\$931.49	\$1,604.53
Arkansas.....	38,720.00	9,470.03	36,496.49	84,686.55			
California.....	160,100.00	202,464.85	239,976.88	602,541.73			
Colorado.....					1,180.00	3,398.57	4,578.57
Connecticut.....	13,750.00	75,193.36	1,815.89	90,762.16	583.82	583.83	1,167.65
Delaware.....	1,400.00	5,799.33		7,199.33	1,300.00	1,341.29	2,641.29
Florida.....	69,000.00	17,240.20	52,037.59	138,277.79	1,610.00	4,146.82	5,756.82
Georgia.....	62,000.00	15,514.20	78,867.15	156,381.35	1,500.00	1,557.95	3,057.95
Hawaii.....	640.00	2,907.99		3,547.99	1,151.75	1,151.75	2,303.50
Idaho.....	65,900.00	52,165.89	170,536.53	288,602.42	1,270.00	2,030.75	3,300.75
Indiana.....	6,246.83	6,246.84		12,493.67	1,630.00	2,921.48	4,551.48
Iowa.....					1,500.00	1,524.35	3,024.35
Kansas.....					854.87	1,333.13	2,188.00
Kentucky.....	4,825.14	5,577.81		10,402.95	1,000.00	2,899.11	3,899.11
Louisiana.....	41,700.00	51,689.35	21,881.05	115,250.40	1,500.00	1,500.00	3,000.00
Maine.....	48,900.00	186,637.75		235,537.75	433.56	433.54	867.10
Maryland.....	11,300.00	40,385.43	251.04	51,937.52	954.00	5,464.45	6,418.45
Massachusetts.....	27,590.00	67,973.92		95,473.92	1,740.00	5,833.49	7,573.49
Michigan.....	105,700.00	422,024.81		527,724.81	1,650.00	6,363.91	8,013.91
Mississippi.....	21,345.00	15,183.30	7,557.59	44,090.89	500.00	633.19	1,133.19
Minnesota.....	91,900.00	374,245.11		466,145.11			

TABLE 2.—Cooperative expenditures for fire protection and for the distribution of forest-planting stock under the Clarke-McNary Act, fiscal year 1935—Con.

State	For fire protection				For the distribution of forest-planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Montana.....	\$30,050.00	\$14,880.39	\$56,975.61	\$101,906.00	\$1,500.00	\$2,720.48	\$4,220.48
Nebraska.....	-----	-----	-----	-----	1,850.00	9,758.47	11,608.47
Nevada.....	1,490.00	211.00	5,393.44	7,094.44	-----	-----	-----
New Hampshire.....	15,400.00	40,437.94	4,855.74	60,693.68	1,700.00	3,438.51	5,138.51
New Jersey.....	29,400.00	96,444.99	-----	125,844.99	1,820.00	10,953.52	12,773.52
New Mexico.....	2,200.00	2,762.00	2,560.00	7,522.00	-----	-----	-----
New York.....	71,800.00	258,458.08	-----	330,258.08	1,880.00	10,274.91	12,154.91
North Carolina.....	48,922.46	40,818.07	8,104.40	97,844.93	1,160.18	1,160.21	2,320.39
North Dakota.....	-----	-----	-----	-----	1,750.00	7,758.23	9,508.23
Ohio.....	5,200.00	9,586.90	-----	14,786.90	1,810.00	9,014.15	10,824.15
Oklahoma.....	11,767.64	7,593.94	4,173.72	23,535.30	1,500.00	2,656.59	4,156.59
Oregon.....	94,200.00	77,433.25	235,975.55	407,608.80	1,500.00	2,072.95	3,572.95
Pennsylvania.....	22,562.00	246,817.43	-----	269,379.43	1,760.00	5,081.94	6,841.94
Puerto Rico.....	-----	-----	-----	-----	1,690.00	5,618.28	7,308.28
Rhode Island.....	2,090.00	15,391.65	-----	17,391.65	-----	-----	-----
South Carolina.....	30,240.00	10,459.81	30,495.32	71,195.13	1,590.00	3,038.00	4,628.00
South Dakota.....	750.00	1,977.67	-----	2,727.67	1,100.00	1,826.78	2,926.78
Tennessee.....	16,876.81	15,832.27	1,044.54	33,753.62	1,500.00	1,857.56	3,357.56
Texas.....	36,200.00	57,329.33	8,043.85	101,573.21	-----	-----	-----
Utah.....	-----	-----	-----	-----	1,000.00	1,392.64	2,392.64
Vermont.....	5,500.00	7,196.12	2,963.94	15,660.06	1,500.00	10,074.53	11,574.53
Virginia.....	21,760.00	34,443.29	2,102.94	68,306.23	1,283.76	1,283.75	2,567.51
Washington.....	93,100.00	98,271.99	168,465.28	359,837.27	1,473.00	2,789.82	4,262.82
West Virginia.....	30,500.00	37,629.20	30,624.29	98,753.49	1,500.00	7,325.41	8,825.41
Wisconsin.....	71,300.00	297,502.57	-----	368,802.57	1,500.00	4,382.81	5,882.81
Wyoming.....	-----	-----	-----	-----	1,011.71	2,218.00	3,229.71
Administration and inspection.....	76,343.58	-----	-----	76,343.58	791.64	-----	791.64
Total.....	1,533,439.46	2,935,564.52	1,195,507.15	5,664,561.13	55,201.33	150,746.64	205,947.97
Forest taxation and insurance study.....	34,900.03	-----	-----	-----	-----	-----	-----
Unexpended balance.....	5,229.51	-----	-----	-----	1,094.67	-----	-----
Total appropriation.....	1,573,619.00	-----	-----	-----	56,296.00	-----	-----

COOPERATIVE PROTECTION OF STATE AND PRIVATE FOREST LANDS FROM FIRE

During the calendar year 1934 the total acreage of State and private forest or potential forest land under some form of organized protection from fire was approximately 237,000,000 acres. This is 56 percent of the total of those lands (427,000,000 acres) classed as needing protection. The area protected in 1933 was 221,000,000 acres. Of this increase of 16,000,000 acres, over 12,000,000 acres was in the South. The Rocky Mountain States showed an increase of over three and one-half million acres, due in large part to a redetermination of the areas in need of protection in Wyoming and Colorado. The areas in the States of the South which account for the largest part of this total are as follows: Virginia, 693,000 acres; West Virginia, 1,154,000 acres; North Carolina, 3,965,000 acres; South Carolina, 851,000 acres; Georgia, 2,770,000 acres; Alabama, 64,000 acres; Louisiana, 145,000 acres; Mississippi, 691,000 acres; Arkansas, 913,000 acres.

The three Lake States showed substantial increases as follows: Michigan, 88,000 acres; Wisconsin, 949,000 acres; Minnesota, 59,000 acres. In only four regions was there a net decrease. This in each case was too small to be significant.

Table 2 shows a total of \$4,131,072 of State and private funds spent in cooperative forest-fire protection in the fiscal year 1935. The corresponding totals for the fiscal years 1932, 1933, and 1934 were \$4,370,274, \$3,141,445, and \$3,794,722. Thirty-nine States cooperated, the same number as in the previous fiscal year. Private expenditures for protection which are provided independently of the organized protective system do not appear in table 2. Their amount is not accurately known, although undoubtedly substantial in the aggregate.

The total area of protected State and private land reported as burned over in the calendar year 1934 was 3,514,570 acres (of which 858,530 acres are classed as not having productive value), as against 3,342,690 acres in 1933, and unprotected forest lands, 37,647,820 acres, as against 40,166,900 acres in 1933. The 2,656,040 acres of protected productive forest land reported as burned over comprised 1.12 percent of the forest area protected. The corresponding percentage for the unprotected area was 20. Of the State and private land burned over in 1934, 91 percent was outside of protected units. The number of fires reported on protected units was 61,254, as against 48,770 in 1933. Of the 1934 number, 27.7 percent were reported as incendiary, as against 22.7 percent in 1933.

During the fiscal year 1935 the development of forest-fire improvements on State and private lands actively continued. The result is marked intensification of the protective effort within protected units. There has been substantial extension of protection to additional areas, and it is believed that with the enlargement of the Civilian Conservation Corps and the increased funds which many of the States have provided for the 1936 forest-fire cooperation work there may be an even larger increase in the areas protected during the present year.

The extent of the improvements contributed by the Civilian Conservation Corps is indicated by such items as the following, which represent the total up to and including March 31, 1935: 15,926 miles of telephone lines, 28,698 miles of firebreaks, 29,783 miles of roads and trails, 575 new look-out towers, 169 look-out houses, and many other improvements; the reduction of fire hazards on 744,204 acres, and a large amount of roadside and trail cleaning.

The foregoing continuous and permanent contribution to the cooperative protection enterprise is of great significance. The future will tell how effectively these improvements will be maintained by the States. The action on many of the Southern States particularly, in providing increased funds for this specific purpose, is highly encouraging.

COOPERATION WITH STATES IN TREE PLANTING

In the calendar year 1934, 20,208,106 trees distributed by States cooperating under section 4 of the Clarke-McNary law were planted in windbreaks, shelterbelts, and farm wood lots by private landowners. This was 8 percent less than in 1933. During the fiscal year a cooperative agreement providing for a new project was executed with Arkansas. This brings the total number of States cooperating to 40, in addition to Puerto Rico and Hawaii. An agreement is in process of execution with still another State, Texas.

The small Federal assistance continues to prove its importance as a stabilizing force. The maximum again set up for any one State was \$1,500. Unless this appropriation can be somewhat increased it will be necessary to reduce the maximum to a quite inadequate sum. Approximately 20,000 acres were added to forest plantations on farms during the fiscal year 1935 as a result of the cooperative projects. The leading States in the number of trees distributed were New York, Pennsylvania, Puerto Rico, Indiana, Wisconsin, Ohio, and Nebraska, each of which distributed more than a million trees for planting on farms.

COOPERATION WITH STATES IN FARM-FORESTRY EXTENSION

The management of farm woodlands to increase their returns and the planting of trees on farms for timber production or shelterbelts are the leading projects in the extension forestry programs of the States. These programs are conducted with the aid of Federal cooperation under section 5 of the Clarke-McNary law, administered by the Extension Service of the Department of Agriculture with the cooperation of the Forest Service. Under this cooperative arrangement 33 States and 1 Territory are employing 38 extension foresters and receiving the cooperative aid of 2 Federal extension specialists.

The various forestry-extension activities during the calendar year 1934 included thinning or "weeding" forest stands on 5,237 farms, selection cutting of trees on 9,681, improved practices of producing maple sugar and sirup on 1,798 and of producing naval stores on 2,914, and cooperation in the prevention of forest fires on 57,749. On 8,929 farms a total of 40,560 acres of land were reforested by planting small trees for timber production. Windbreaks

shelterbelts were established by 8,557 farmers, while 5,229 farmers planted trees to check soil erosion. More than 1,100 farmers followed recommendations for timber estimating and appraisal, 2,895 for marketing forest products, and 7,027 for preservative treatment of farm timbers. All together, 22,715 farmers planted trees for different purposes on their farms.

Boys and girls to the number of 13,429 were enrolled in 4-H forestry clubs, and 10,340 of these completed projects in growing trees in nursery beds, planting land with trees, thinning, weeding, or pruning forest trees, and protecting 38,544 acres of farm timberland from fire.

NATIONAL-FOREST ADMINISTRATION

The expenditures for national-forest administration, protection, improvement, reforestation, and extension, totaling \$75,933,994.83, are shown in detail on page 53.

The Federal funds made available for the national-forest enterprise in the fiscal years 1934, 1935, and 1936 are shown in table 3.

TABLE 3.—*Direct appropriations¹ and supplementary allotments of Federal funds for the national-forest enterprise, 1934-36*

	1934 ²	1935 ³	1936 ⁴
General expenses of administration, protection, and improvement.....	\$6,047,321	\$6,684,459	\$7,745,984
Specifically for:			
Fire control.....	524,450	2,460,487	112,561
Improvements, tree planting, etc.....	15,350,397	382,206	9,833,924
Land acquisition.....	18,965,000	11,535,000	14,832,150
Forest development, roads, and trails (construction and maintenance).....	10,350,000	3,000,000	3,328,000
Forest highways (construction and maintenance).....	19,057,400	8,500,000	4,082,600
Total.....	70,294,568	32,562,152	39,935,219

¹ Less administrative reductions imposed by the Bureau of the Budget

² Of the amounts shown for 1934, \$58,647,745 was derived from allotments of National Industrial Recovery Administration funds, available for expenditure until June 15, 1935.

³ The fourth entry in this column represents an allotment of \$11,035,000 from National Industrial Recovery Administration funds, available for expenditure until June 15, 1935, and an allotment of \$500,000 from the emergency relief appropriation, available until June 30, 1937.

⁴ The fourth entry in this column represents allotments from the emergency relief appropriation, available until June 30, 1937.

The last two entries in the 1934 column of table 3 are not in full accord with the showing made in last year's report because of changes in the allotments which increased the forest-development road funds by \$100,000 and decreased the forest highway funds by \$400,000. The second entry in the 1935 column is greater by \$2,348,000 than the corresponding entry in last year's report, which showed merely the nominal amount appropriated in advance for fire-fighting expenditures. As usual, this was supplemented later by a deficiency appropriation to replenish other funds temporarily drawn upon for fire fighting, thus bringing the total to the amount shown above.

THE NATIONAL-FOREST PROPERTIES

The gross area of the national forests on June 30, 1935, was 188,292,217 acres, of which 24,982,215 acres were in ownership other than that of the United States; leaving the net area 163,310,002 acres. During the year the gross area of the national forests, as fixed by Presidential proclamations or Executive orders or by acts of Congress, increased by 255,194 acres; the net area, by 718,878 acres. If to this be added 1,860,117 acres acquired under the Weeks law but not yet covered by proclamation or Executive order, the total net national-forest area is raised to 165,170,119 acres.

Table 4 shows the additions and eliminations.

TABLE 4.—National-forest additions and eliminations, fiscal year 1935

National forest	State	Additions	Eliminations	National forest	State	Additions	Eliminations
		Acres	Acres			Acres	Acres
Absaroka.....	Montana.....	1 80		Harney.....	South Dakota.....		
Arapaho.....	Colorado.....	1 160		Kootenai.....	Montana.....	1 3,758	2 10,175
Do.....	do.....	1 320		Lolo.....	do.....	5 640	
Blackfeet.....	Montana.....	1 7,799		Do.....	do.....	5 61	
Do.....	do.....		2 9,635	Do.....	do.....	1 1,588	
Do.....	do.....	1 160		Ochoco.....	Oregon.....	1 180	
Black Hills.....	South Dakota.....	2 1,556		Regue River.....	do.....	1 240	
Do.....	do.....	1 160		Shasta.....	California.....	1 160	
Do.....	Wyoming.....	1 320		Siskiyou.....	Oregon.....	3 59,593	
Do.....	do.....	1 120		St. Joe.....	Idaho.....	4 83,042	
Do.....	South Dakota.....	1 80		Tongass.....	Alaska.....	2 544	
Chippewa.....	Minnesota.....		3 168	Do.....	do.....		2 7
Chugach.....	Alaska.....		2 4	Do.....	do.....		2 4
Do.....	do.....		2 14	Do.....	do.....		2 2
Cibola.....	New Mexico.....		2 2	Do.....	do.....		2 29
Do.....	do.....		3 11,931	Do.....	do.....		2 7
Clearwater.....	Idaho.....	4 7,321		Tusayan.....	Arizona.....		2 5,760
Deschutes.....	Oregon.....	1 160		Uinta.....	Utah.....	2 17,741	
Do.....	do.....	1 31,244		Wasatch.....	do.....	2 57,501	
Do.....	do.....	1 32,891		Wenatchee.....	Washington.....	1 480	
Flathead.....	Montana.....	1 743		Whitman.....	Oregon.....	1 2,401	
Gunnison.....	Colorado.....	4 240					
Harney.....	South Dakota.....	1 2,425		Total.....		313,599	38,077

¹ Private lands acquired through exchange.

² Made by Presidential proclamation or Executive order.

³ Made under acts of Congress.

⁴ Made by donation of private lands.

⁵ By purchase for administrative use.

The gross area changes in detail were: 701 acres added by purchase for administrative purposes, 90,603 acres by donation, 77,342 acres by Executive order, 85,360 acres through acquisition by exchange of lands outside of national forest boundaries, and 59,593 acres by an act of Congress; while 25,977 acres were eliminated by Executive order and 12,009 acres by acts of Congress, and area recomputations based on better data deducted 20,339 acres.

The act of Congress added to the Siskiyou National Forest in Oregon highly productive timberland, to pass ultimately to Federal ownership through donation by the present owners. The additions by Executive orders were of 1,556 acres to the Black Hills National Forest in South Dakota, 17,741 acres to the Uinta National Forest in Utah, and 57,501 acres to the Wasatch National Forest in Utah. The donations comprised 7,321 acres added to the Clearwater National Forest in Idaho, 83,042 acres on the St. Joe Forest in Idaho, and a small area on the Gunnison in Colorado. The most important additions through exchange were two, aggregating 64,135 acres on the Deschutes in Oregon, and lesser one on the Blackfeet, Kootenai, and Lolo in Montana, and the Whitman in Oregon. The remaining acquisitions through exchange were in numerous widely scattered small holdings.

The principal eliminations by Executive orders were of approximately 9,635 acres from the Blackfeet Forest in Montana; 10,175 acres from the Harney National Forest in South Dakota; 5,760 acres from the Tusayan National Forest in Arizona; and 387 acres from the Tongass National Forest in Alaska, the latter to permit of entries under the Trade and Manufacturing Act for land occupied and developed under special-use permit. From the Cibola National Forest in New Mexico 11,931 acres were eliminated by an act of Congress which added them to the Navajo Indian Reservation. The other changes were of minor character and involved numerous widely scattered areas.

Improved transportation and communication facilities permit larger areas to be managed efficiently by a single forest supervisor. In consequence the Blackfeet Forest was partitioned between the Flathead and the Kootenai Forests; the Selway was merged with the Bitterroot, the Clearwater, the Lolo, and the Nez Perce; and the Tusayan was divided between the Kaibab and the Prescott.

National forests are required not only for timber production and watershed protection but also for such services and functions as outdoor recreation, wild life propagation and soil-erosion control. The study conducted as a part of the survey and report of the National Resources Board in 1934 indicated that they

should be enlarged by approximately 132,000,000 acres, of which about 14,000,000 acres should be withdrawn from the unreserved public domain and 118,000,000 acres acquired from present private owners by purchase, exchange, or donation. In large part, present national-forest boundaries are arbitrary, excluding minor and marginal but integral parts of the forests, watersheds, and range lands which they were designed to protect and thus greatly increasing the difficulty and cost of management, and correspondingly diminishing its effectiveness. One of the first constructive approaches to the inauguration of a Nation-wide land-use program would lie in the extension of the national forests to their suitable limits. If that were done, approximately one-seventh of the land area of the continental United States would be under carefully planned, unified, multiple-use management, and some of what are now the most acute problems in land economy would approach solution.

LAND ACQUISITION THROUGH EXCHANGE

The wide interspersal among the national-forest lands of properties not under the same control creates serious problems of protection and increases the cost of administration. As has repeatedly been emphasized in former reports, one-half or more of the 25 000 000 acres of State and private lands now within the forest boundaries should be incorporated to facilitate the protection, management, and utilization of the natural resources. Adjoining the national forests are other private lands equally essential to their best development and use which should also be acquired.

One long-established and widely authorized method of acquiring such lands is through grants in exchange of not to exceed equal values of national-forest land, stumpage, or both, in the same State. There are now on the statute books 58 laws authorizing such exchanges, and there are pending before the Seventy-fourth Congress 10 additional bills to extend the provisions of the general exchange law of March 20, 1922 (42 Stat. 465), to certain described areas outside of but adjoining the national forests. This exchange work is conducted with as much care in the appraisal of offered lands as though cash were to be paid for the properties. It is carefully safeguarded by established legal requirements and has been free from valid criticism. Except where departures have been recommended by the counties concerned in order to continue the operations of logging enterprises and the employment incident thereto, the rule has been followed of limiting the use of salable stumpage for exchange purposes to valuations not exceeding 10 percent of the timber sold for cash in the same State and year.

The agreement under which the State of Colorado will select approximately 70,000 acres from land now within the Routt National Forest in exchange for an equal area of widely scattered school sections progressed toward consummation. Questions of valuation of the base and selected lands somewhat retarded the progress of the pending exchange with the State of New Mexico, but hope exists that this exchange may be consummated in the near future. Under the understanding with the State of Michigan whereby lands are purchased within established State forests with intent to exchange them for State lands within the national forests, the National Forest Reservation Commission gave approval to the purchase of approximately 160,000 acres of private lands within the State-forest limits, and the consummation of the exchanges is now well under way. The net result will be that the expenditure of Federal funds as authorized by the act of March 1, 1911 (36 Stat. 961), will place under Federal ownership lands of the full value of the expenditures, and at the same time place under State ownership lands of equal value; thus furthering both the Federal and the State programs of forest conservation in very marked degree. Similar plans might profitably be inaugurated in other States.

During the fiscal year 1935 there were reconveyed to the United States 179,613 acres of private land, valued at \$478,160, in exchange for 2,017 acres of national-forest land and 191,866,000 board feet of national-forest stumpage valued at \$418,046; the net national-forest areas thus being increased by 177,596 acres. In the same fiscal year 76 exchange cases were approved by the Secretary of Agriculture and referred to the Secretary of the Interior for further action. These cases contemplate conveyance to the United States of 124,731 acres of privately owned land in exchange for 25,063 acres of national-forest lands and \$333,113 worth of stumpage. From the beginning of the

exchange work to June 30, 1935, 1,120 land-exchange cases have been consummated. Through them the United States has acquired 1,743,521 acres of land valued at \$6,338,060, in exchange for 464,940 acres of national-forest land valued at \$2,034,073, and 1,287,330,000 board feet of national-forest stumpage valued at \$3,470,144. Not only have these exchanges increased the net national-forest area by 1,278,581 acres but they have also increased the total volume of merchantable stumpage on national-forest lands, as the acquired lands support a larger volume of stumpage than that granted in exchange for them. Additionally, the passage of the acquired lands to Federal ownership and management has eliminated many difficult and expensive problems of protection, administration, and utilization.

LAND ACQUISITION THROUGH PURCHASE

In December 1934 an additional \$10,000,000 of the fund made available by the Emergency Conservation Act of March 31, 1933, was allotted by the President for the acquisition of forest lands under the provisions of the act of March 1, 1911. That amount, plus the unobligated balance of the \$20,000,000 previously allotted, made possible a program of land acquisition through purchase closely approaching that of the preceding year. By the creation of 1 new national-forest purchase units, purchase work was initiated in the States of Indiana, Iowa, North Dakota, and Ohio, while additional units were created in other States and substantial additions were made to various units formerly established. The number of units was thus increased from 69 to 92, situated in 27 of the States east of the Great Plains and in Puerto Rico; and their gross area was increased from 31,399,662 acres to 47,941,337 acres.

The 3,661,848 acres approved for purchase during the year brought the total approved to 12,946,528¹ acres. An additional 159,825 acres was approved for purchase within 13 of the State forests of Michigan, with a view to exchanging them as explained above. Since the purchase areas include 2,227,395 acres reserved from the public domain and 252,418 acres acquired through exchange at the close of the year the United States owned or was in process of acquiring a total of 15,586,166 acres of forest lands in the eastern half of the country, but about 24,000,000 acres more must be acquired to complete the existing system of units.

Some specific requirement or objective of public interest dictated the establishment or enlargement of each purchase unit. Those established in Ohio and Indiana were to protect important parts of the watershed of the Ohio River from further forest denudation and excessive soil erosion. The units established in Iowa likewise occupy areas where long-continued agricultural use has seriously impaired the vegetative cover and has greatly accelerated land deterioration and soil movement. The two additional units in Missouri protect important parts of the watersheds of the Black, the White, the St. Francis, the Missouri, and the Mississippi Rivers. The units in North Dakota are to permit the initiation of reforestation and afforestation activities in parts of that State where tree growth is of major importance. The Delta unit in Mississippi was designed to put under management an area of the hardwood type in that State. In Louisiana, the Kisatchie Forest was extended over a large additional acreage important for both watershed protection and timber production. The Manistee unit in Michigan was doubled in size to give proper protection to an area where timber production obviously constitutes the highest economic and social use of the land. This likewise was the objective in largely increasing the size of the Ozark unit in Arkansas, and in adding materially to the Ouachita unit in the same State. The establishment of four new units in Alabama, plus the material enlargement of the existing Alabama unit, was to make permanent the gains in forest protection initiated by private agencies unable to continue the work.

The keen interest displayed in the extension of land purchases to the Western States was manifested by the enactment by the States of California, Oregon, Montana, Idaho, and Utah of the acts of consent required under the Weeks law. Within those States now exists the most acute phase of the forest problem, because of private ownership of excessive volumes of stumpage. Driven by an impossible burden of accumulated and pyramiding carrying

¹ Last year's report showed a total of 9,588,884 acres approved for purchase at the close of the fiscal year 1934—an apparent discrepancy with the figures given above. Defective titles and similar causes occasionally prevent the consummation of approved purchases. The acreage involved are thereupon deducted from the totals recorded as approved. In other cases resurveyors change the average figures. Thus, the totals are subject to frequent minor revisions.

charges, owners of this stumpage are seeking to liquidate it as rapidly as possible. Cutting is in excess of demand, is conducted as a rule without regard to preservation of the forest capital, is threatening the economic life of dependent communities and counties, and is creating a more or less chaotic condition in all of the forest regions of the United States. Timber manufactured at a sacrifice of stumpage values, and frequently also of working capital, by competing destructively with the products of other regions forces them in turn into uneconomic and destructive utilization. Public repossession of some of the excess stumpage of the Western States, upon terms of purchase equitable alike to the public and the private landowner, would do much to relieve this condition, and thus would stabilize and promote forestry throughout the country. It would be the soundest of public policy to acquire as promptly as possible those areas of privately owned stumpage in the West which by their location control in large measure the orderly utilization of surrounding national-forest lands. So acquired, these areas could be placed completely under sustained-yield management, their timber products would be cut only in balance with growth, their contribution to the general supply of timber would be more in proportion to their productive power and less destructively competitive with other sources of supply, and conditions would be created under which the forest lands of the United States more nearly could be placed on a sound basis of sustained-yield management.

The acquisition program continued the opportunity for emergency employment, providing additional fields for constructive work by the Civilian Conservation Corps and by men employed under the relief program. The cash paid for the lands also helped the economic situation of the local communities in marked degree.

During the year title was taken under the Weeks law, as amended by the Clarke-McNary law, to 2,027,926 acres at a cost of \$5,056,523. Purchases totaling 3,661,848 acres and creating a total obligation of \$14,542,422 were approved by the National Forest Reservation Commission. The average price was \$3.97 per acre for the lands approved for purchase and \$2.49 for the lands actually acquired, as compared with the previous average of \$3.39 and \$4.28, respectively.

At the close of the year the total actually vested in Federal ownership was 7,134,650 acres; its total cost, not including overhead, was \$26,947,338, and the average price per acre was \$3.74. The distribution of these lands is shown by States in table 5.

TABLE 5.—*Acreage of timberland purchased in the fiscal year 1935 and total purchases to July 1, 1935*

State	Purchased in 1935	Average price per acre	Total purchased up to July 1935	State	Purchased in 1935	Average price per acre	Total purchased up to July 1935
	<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>		<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>
Alabama.....	692	4.29	118,230	North Carolina.....	56,252	2.79	494,847
Arkansas.....	61,933	2.48	412,255	Oklahoma.....	31,491	1.57	92,280
Florida.....	197,515	2.42	443,937	Pennsylvania.....	11,267	4.25	383,745
Georgia.....	43,772	4.06	390,261	Puerto Rico.....	1,040	10.00	1,040
Illinois.....	10,374	5.36	10,374	South Carolina.....	25,774	5.05	115,441
Kentucky.....	70,645	2.57	70,835	Tennessee.....	6,431	3.40	398,770
Louisiana.....	272,553	1.92	363,811	Vermont.....	27,027	9.20	58,408
Maine.....			33,781	Virginia.....	10,399	3.45	563,619
Michigan.....	124,736	2.55	533,264	West Virginia.....	188,400	2.58	578,956
Minnesota.....	236,228	2.47	468,447	Wisconsin.....	228,124	1.98	610,428
Mississippi.....	212,139	2.43	350,772				
Missouri.....	201,782	1.88	212,225	Total.....	2,027,926	2.49	7,215,493
New Hampshire.....	9,412	5.35	510,367				

COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

Three bills which would transfer large areas from a national forest to a national park status received the attention of the Seventy-fourth Congress but were not acted upon at the first session. One bill would approximately double the present Mount Olympus National Monument area and designate it the Mount Olympus National Park. A second would establish as the Kings Canyon National Park the large area comprising the Kings Canyon division of the Sequoia National Forest in California. The third would extend the boundaries

of the Grand Teton National Park in Wyoming to include a large part Jackson Valley and about 55,000 acres of land now in the Teton National Forest. These proposals raise complicated questions, involving both local and national interests. They would involve in each case the withdrawal from industrial or commercial utilization of national resources of large volume and importance, and would to that degree affect the present or prospective regional economy. If detailed analysis of all the factors involved establishes that the areas are not of such superlative scenic quality or unique scientific, educational, and recreational value as to make them truly of national interest, and if due regard for the needs of dependent communities make controlled utilization of all the natural resources within the areas, including their recreation and inspirational values, in best accord with the public interest, the lands should remain in their present status rather than be converted into hybrid national parks not in suitable conformity with established park standards and in large measure duplicating the functions of the national forests.

NORTHERN PACIFIC LAND-GRANT ADJUDICATION

The suit authorized by the act of June 25, 1929, to adjudicate the equity of the Northern Pacific Railroad Co. under the land grant of July 2, 1864, the resolution of May 31, 1870, and other supplementary laws continued to receive judicial attention. The proceedings were almost wholly of a legal nature, with the Department of Justice representing the Federal Government, little participation by the Forest Service being necessary.

PURCHASES AND DONATIONS OF LANDS FOR ADMINISTRATIVE PURPOSES

Oftentimes suitable sites for essential administrative structures cannot be found upon national-forest land. In a number of instances local people have been glad to donate tracts to meet this need, and such donations have been accepted by the Secretary under the act of March 3, 1925 (43 Stat. 1132). In 13 instances small tracts were purchased, at a total cost of \$40,194, under the provisions of the acts of March 3, 1925 (43 Stat. 1132), and June 16, 1924 (48 Stat. 195); and 18 other purchases were in process of consummation at the close of the fiscal year.

SPECIAL USES

At the close of the fiscal year 38,683 special-use permits were in effect, as against 37,969 at the close of the previous year. They comprised 17,978 issued without charge and 20,705 involving an annual rental. The special-use receipts for the fiscal year 1935 were \$315,829.49, an increase of \$17,998.74 over the previous year.

For several years this report has pointed out the desirability of an increase in the maximum area of 5 acres allowable under term permits issued under the act of March 4, 1915. Experience has proved that maximum to be entirely too low to permit in many cases the best development of the occupied areas and the highest service to the public. The present method of meeting the situation where a desirable form of development requiring a larger area is in question is to issue a term permit for 5 acres and a separate terminable permit for the additional area. Such forms of use as occupancy for airplane landing fields, scientific stations of educational institutions, or high-grade resorts require substantial investments, for which insecurity of tenure is inappropriate. Term permits covering areas adequate to meet well-established needs would contribute greatly to economic development and would enlarge the income derived from the forest lands by the Federal Government and the counties. Amendment of the act of March 4, 1915, to increase the maximum area to 80 acres is greatly to be desired, in the public interest. Only in exceptional and well-justified cases would permits be issued for areas of as much as 80 acres, and the majority would not exceed the present limitation.

CLAIMS AND SETTLEMENT

During the fiscal year reports on applications for homestead patents totaled 61, of which 56 were favorable and 5 were unfavorable; while reports on applications for mineral patents numbered 55, of which 53 were favorable and 2 unfavorable.

Applications or appeals for the reclassification and listing of national-forest lands under the forest homestead law were negligible in number. Numerous

areas previously listed for entry under that law were recalled because of the now evident fact that they are not valuable for agricultural use and if passed to private ownership would merely create that many more submarginal farms. During the year there were introduced in the Seventy-fourth Congress two bills which would withdraw from entry under the mining laws of the United States two areas not believed to contain appreciable mineral values, but of great importance for other forms of public use and occupancy. One bill related to a part of the Prescott National Forest in Arizona; the other to a part of the Santa Barbara National Forest in California. While withdrawing the described lands from the operation of the mining laws, the bills provide for the restoration to mineral entry of lands found by the Secretary of Agriculture to be chiefly valuable for that purpose.

PROTECTION FROM FIRE

The deficiency in precipitation which has been accumulating during the past 15 years reached a new peak in the great drought of 1934. It was a national calamity, and as might be expected, created an exceedingly difficult fire-control problem on the national forests. When burning conditions are critical, fires are caused by actions and events which under more normal conditions would be harmless. Consequently the number of fires is often an index of the severity of the fire danger. In 1934, 10,871 fires were fought by Forest Service crews, as compared with 6,315 in 1933 and 7,037 in 1932. While part of this great increase came from fires on new territory added to the national forests east of the Great Plains, 64 percent more fires were fought in 1934 than in 1933 in the western national forests, where no material boundary changes took place.

The continued drought, increased use of the forests for recreation, large areas of timber killed by insect infestations, and other factors are developing many of the so-called "border-line" fire forests into forests of major fire difficulty. In Wyoming, Montana, Utah, Colorado, and elsewhere national forests on which fires have been handled by cooperating local settlers with only a skeleton Forest Service organization were so endangered in 1934 that a thorough strengthening of their organizations became imperative. On forests where fire control is normally difficult, the danger was greatly intensified. In the Northern Rocky Mountain Region, for example, an unusually early and large number of lightning fires broke out before the guard stations had been manned. Between May 15 and June 10 the peak 10-day load was 150 fires; the greatest number recorded in previous years was 40. The physical difficulties incident to fire control in log-encumbered old burns, the heavy, persistent smoke blankets originating from Canadian fires and from the Pete King-McLendon Butte fire on the Selway, and particularly the persistence of low-humidity periods were other reasons for the exceptionally large total area burned in this region. In Utah, where conditions were representative of the entire Intermountain and Rocky Mountain Forest Regions, the drought was generally acknowledged as being without precedent since white settlement.

The increasing difficulties of protection, which have been discussed in former reports during the past decade, have been largely offset by improved defensive strategy and tactics. In 1934 betterments in organization, more rapid and heavier mobilization of man power, vigorous and skillful leadership, and material for initial attack proved their value. Full use of newly built roads, new trucks, and the numerous Civilian Conservation Corps and other emergency crews contributed further. For example, on one fire in the Angeles National Forest, in California, 1,400 Civilian Conservation Corps workers were thrown into action within a few hours.

In most places the Forest Service was able to meet the situation. More suppression squads—organized, trained, and equipped—were in use, ready to launch the fastest possible attack. The Ponderosa Way, a firebreak and truck trail along the Sierra Nevada, constructed in major part by Civilian Conservation Corps crews, was employed repeatedly to prevent the invasion of the timber belt by fires originating in the brush and grasslands below it. Portable radio equipment developed by the Forest Service made possible fast communication on difficult fires, in place of a slow messenger service.

Detailed studies of needs for full coverage of forest areas by an organized look-out system were completed in several regions and the needed structures supplied. Discovery has thus been materially speeded up. Supplementing this, a fresh study of the communication system of telephone lines and radio brought to light new requirements which have now largely been met, saving precious

minutes in reporting fires to the control forces. Great progress was made in detailed analysis of the needs for roads and trails to permit reaching fire-hazard areas within the time limits necessary for confining the fire to a small acreage and many urgent needs were met through construction of the required facilities. The results of past years of fire research are becoming increasingly valuable. A mobile fire-weather forecasting unit, operated by the Weather Bureau in cooperation with the Forest Service and manned by skilled forecasters, has proved its worth. Methods of rating fire hazard currently, developed by the forest experiment station in the northern Rockies and by other forest officers in the Intermountain Region, are in general use in those sections and are removing guesswork from decisions on the requisite intensity of preparedness measures and the weight of attack to be thrown against fires. Technical advances such as these are resulting from carefully planned research projects aimed at specific fire-control problems. The application of findings to current practice ordinarily lags but little.

For many years the problem of fires in the exceedingly inaccessible "back country" of the northern Rockies has been recognized as one of the most perplexing facing the Forest Service. The almost unsurmountable difficulties of supply confronting the Service led to a type of fire-control strategy under which relatively small crews of men engaged in long campaigns to suppress individual fires. Fought in this way, some fires attained uncontrollable size, and the areas burned over at times became very large. While forest values per acre were not so high as in many of the more accessible national forests, this basic strategy made the total losses entirely too heavy. This whole problem, studied anew in the field by a representative committee in 1932, was examined at a staff conference in April 1935. The decision was reached to apply to "back country" fires principles and practices similar to those long used elsewhere on the national forests.

These call for quick attack, with forces calculated to control the fire before the active burning period of the day following discovery. Analysis of actual results on thousands of fires shows that the sum total of fire costs, made up of preparedness expenses, suppression costs, and damage, tend to be markedly lower with aggressive handling of fires than when long campaigns and sacrifice of acreage are involved. This expansion into new territories of the quick-action strategy should further reduce the western fire losses. The policy has been in effect during the 1935 season, but has not yet received a severe test. However, the cumulative effect of past emphasis on quick control of all fires is increasingly evident. One way in which the Forest Service judges the technical success of fire control is the extent to which fires that continue to spread during the day after discovery are eliminated. A sharp reduction in the number of such fires indicates increasing ability to mobilize, develop strategy, and execute control action. The new expansion of the quick-control policy evidently has been a factor.

An additional year's use of Civilian Conservation Corps crews on thousands of fires permits a reasoned judgment as to the value and limitations of this organization in fire suppression. When organized into suppression squads intensively trained in the technic of fire fighting and led by experienced foremen, the Civilian Conservation Corps men learn quickly, have high morale and develop into effective and skilled suppression crews. Willingness to work at a fast pace on short campaigns and to follow trained leaders into difficult situations are characteristics. When the leadership is not fully trained in fire control because of the necessity of selecting many foremen without adequate fire-suppression experience, the Civilian Conservation Corps crews are similar to other crews so led.

The Civilian Conservation Corps enrollees are most effective on short, sharp suppression jobs. On campaigns lasting over 4 or 5 days and involving night shifts in difficult and dangerous country, when the stimulus of excitement has disappeared and cumulative fatigue becomes important, the output drops markedly, falling definitely below that of older, more seasoned men, who readily adapt themselves to a protracted, unpleasant, and fatiguing job.

The basic organization of the Civilian Conservation Corps project, with large camps and a limited number of spike camps, results in spotty and incomplete coverage of the areas of fire danger. The regular fire-suppression organization of the Forest Service is built on the fact that a large number of suppression units of one or a few men each catches more small fires than fewer units of more men. Thus, the basic organization of the Civilian Conservation Corps precludes its fully replacing the regular fire-control organization. But it has made for a very substantial gain in catching small fires, in speeding up

suppression jobs on larger fires, and in substituting trained and organized crews for the pick-up crews formerly used. In the preparedness phase of fire control also—the construction of truck, horse, and foot trails, look-out houses and observatories, guard cabins, firebreaks, and telephone lines, and various types of hazard reduction—the Civilian Conservation Corps contributions have been exceedingly helpful and valuable.

Table 6 shows the 1934 fire record, in comparison with that of 1933, and the 5-year average for 1930-34.

TABLE 6.—Comparison of fires on national forests, calendar years 1934, 1933, and 5-year average, 1930-34

Item	Fires			Percentage of total		
	1934	1933	Average, 1930-34	1934	1933	Average, 1930-34
Class:	<i>Number</i>	<i>Number</i>	<i>Number</i>			
Burns of 0.25 acre or less.....	6,023	3,625	4,625	55.40	57.42	56.30
Burns of between 0.25 and 10 acres.....	3,139	1,777	2,246	28.88	28.14	27.34
Burns of 10 acres and over.....	1,709	912	1,344	15.72	14.44	16.36
Total.....	10,871	6,315	8,215	100.00	100.00	100.00
Cause:						
Railroads.....	239	94	152	2.20	1.49	1.85
Lightning.....	4,773	2,307	3,343	43.91	36.53	40.70
Incendiarism.....	1,118	708	1,165	10.28	11.21	14.18
Debris burning.....	550	305	373	5.06	4.83	4.54
Lumbering.....	116	90	93	1.07	1.43	1.13
Camp fires.....	991	698	829	9.11	11.05	10.09
Smokers.....	2,582	1,869	1,850	23.75	28.65	22.52
Miscellaneous.....	502	304	410	4.62	4.81	4.99
Total.....	10,871	6,315	8,215	100.00	100.00	100.00

Calendar year	Total area of national forest land burned over	Total damage of national forest land burned over	Total cost of fighting fires, exclusive of time of forest officers
	<i>Acres</i>	<i>Acres</i>	
1934.....	555,309	1,720,365	¹ \$3,175,543
1933.....	132,147	324,758	² 935,339
5-year average, 1930-34.....	346,227	1,322,922	2,069,981

¹ \$1,040,507 of this amount were Emergency Conservation Works funds.

² \$993,532 of this amount were Emergency Conservation Works funds.

THE 1935 FIRE SEASON

Conditions during the 1935 fire season to the date of this report have been far from favorable, though less severe in most of the country than in 1934. As against an average of 6,373 fires prior to September 1 during the preceding 4 years, the number this year was 7,795. Despite the high hazard so indicated, the area burned has been not much more than half of the 5-year average. This reflects increased speed in discovery and attack and more effective suppression action. The number of "extra-period" fires—those not controlled before the burning period of the first day following discovery—was reduced practically 50 percent below the 1931-34 average for the same months; and a like reduction was made in special fire-protection costs. Better organization and training, the availability and more skilful use of Civilian Conservation Corps workers, better placement of fireguard forces under plans embodying the results of painstaking fire studies, and unusually aggressive and powerful action on those fires which could not be held to a small size by the guard forces have been among the most important reasons for the reasonably satisfactory results during the season.

Critical conditions early in the year in the Southeastern States accounted for practically half of the total area burned; usually the major losses are in the far West. One fire in Florida was swept from outside the national-forest boundary by a 45-mile gale northeast through the Ocala National Forest and Game Refuge, burning a strip from 1 to 3 miles wide and about 18 miles long. After this early period no extreme difficulties were encountered

on the national forests east of the Great Plains. The worst conditions in the West developed in the belt of country extending from the Black Hills in South Dakota through Wyoming and eastern Montana and southern Idaho to the Snake River. Here the severe cumulative effects of many years of drought mentioned in earlier reports, have not yet been appreciably alleviated. Nevertheless, for the reasons specified above, the fires in this section were kept from getting seriously out of hand.

In 1935, only two fire fighters' lives were lost on the national forests. William Silva, a Civilian Conservation Corps enrollee, was killed on the Rogue River Forest, and Melvin Richardson, a temporary employee, on the Willamett Forest.

PROTECTION FROM TREE DISEASES, INSECTS, AND RODENTS

During the calendar year 1934 good progress was made in control of the white pine blister rust. Control is accomplished by the elimination of the alternate host plants of the disease—shrubs of the genus *Ribes*. It is being achieved in several ways. Where the *Ribes* are scattered and occur in known situations they are pulled by hand, care being taken to see that no portion of the roots is left and that the pulled plants are placed well above the ground. When found in dense, almost pure stands, as along streams, their foliage is sprayed with poison which permeates into the roots, thus killing the plants. Or, where the terrain permits, they are rooted out with a heavy road-grader type of machine, and the bushes are windrowed and burned.

The Forest Service looks to the Bureau of Entomology and Plant Quarantine Control for the technic of control, and cooperates very closely with this Bureau in the actual operations. In northern Idaho and western Montana, the home of the western white pine, where the disease offers the greatest threat, 408,206 acres of national-forest land were cleaned of *Ribes* during the year, bringing the aggregate to more than 680,000 acres. As the area within the national forests of this region estimated to require treatment was originally 1,500,000 acres, the initial job is nearly one-half completed. In the Northeast, the Appalachians, and the Lake States, where the northern white pine occurs, national-forest lands aggregating nearly 102,000 acres were cleared of gooseberries and currants. In California and Oregon, where sugar pine—the largest of five-needled pines—is found, 119,424 acres of national-forest lands were treated. In addition, 3,000 acres in Oregon were freed of *Ribes* to give protection to two eastern white-pine experimental plantations. The large increase in the scope of this work was made possible by the Civilian Conservation Corps camps and the availability of funds from the Public Works Administration.

Bark beetle epidemics continued through the calendar year 1934. In California there was a marked increase in infestations by the western pine beetle in the east side ponderosa pine stands on the Modoc, Lassen, and Plumas Forests, ranging from 20 to 80 percent over 1933. On one tract on the Modoc treatment in 1933 had failed to check this rising infestation to any appreciable extent. In general, however, the new infestations on treated tracts were much below those on untreated lands. A noteworthy development on these forests was the extension of heavy infestations into the better site areas, and even into adjoining west-side stands, where formerly endemic conditions prevailed. Except for this overlap from east-side infestations, ponderosa pine stands on the west side remained about the same as in 1933, and conditions were generally endemic.

On the Stanislaus and Sierra Forests, where control work was done in 1933, endemic conditions prevailed for the most part. Five newly infested areas of moderate size were treated on the Stanislaus, two of which were adjacent to and partly within the Yosemite National Park and were cooperatively handled by the Park Service and the Forest Service. No new epidemics developed on the Sierra Forest. In all, 13,333 trees were treated on the national forests of California in 1934.

Conditions in Oregon did not vary greatly from those in California. The same marked increase of the western pine beetle infestations occurred in ponderosa pine stands. Control work was done on the Ochoco, Deschutes, and Rogue River Forests. The mountain-pine beetle infestation in lodgepole pine in the vicinity of Sun River Pass, on the Rogue River Forest, mentioned in last year's report, required maintenance control to prevent further increase. In all, 12,905 trees were treated during the year.

In the spring of 1934 treatment was again given to Douglas fir stands along the north fork of the Shoshone River, in the Shoshone National Forest, Wyo.

This was the first time spring treatment had been tried; the fact that no fall work was necessary on the same areas speaks well for this treatment. The advantage of spring control is that the parasites of the *Dendroctonus* beetles have emerged when the trees are treated, and are therefore not destroyed; in the fall the larvae of these parasites are in the trees and are killed along with the beetles. The rather heavy control work initiated in 1933 on the Medicine Bow Forest, Wyo., was continued in 1934. This infestation, while occurring largely in limber pine, seriously threatened valuable tie stands of lodgepole pine, since the same beetle infests both species. Occasionally epidemic conditions developed in the lodgepole pine on small areas, but prompt control measures prevented wide-spread epidemics. In Colorado the Black Hills beetle attained epidemic proportions in stands of large and valuable ponderosa pine on the Montezuma and Uncompahgre Forests, and required immediate control. Indications are that the situation is now well in hand. A total of 56,973 trees was treated during 1934 in Wyoming, Colorado, and South Dakota.

Control of the mountain pine beetle in lodgepole pine stands was continued on the Cache, Wasatch, and Ashley National Forests in southern Idaho. This infestation has been running for a number of years, and, though thought to have been under control a number of times, is constantly breaking out afresh. During the year 25,631 trees were treated. In northern Idaho no extension of the work on the Coeur d'Alene Forest was necessary, but heavy wind throw in the early spring of 1934 on areas previously treated may call for additional work on these areas. On the Kootenai Forest in Montana, 2,930 white pine trees, on six different areas infested with the mountain pine beetle, were treated in the spring and fall of 1934. This was largely maintenance control, needed as the result of heavy windfall during the winter of 1933-34.

With the continuation of drought conditions, there was no appreciable change in the status of the June beetles, which have proved such a problem in connection with reforestation in the Lake States. Before any area is selected for planting, careful tests are made to determine the grub population. Only areas are planted which show not more than two grubs to the square foot. Experiments have shown that on sites carrying no greater distribution than this, the probability of damage is relatively small.

Rabbits continued to do serious damage to the Lake States forest plantations. While in some localities the rabbit population seemed to drop off materially, in others there were apparent increases, so that on the whole the situation changed little. A carefully organized campaign waged throughout the spring, fall, and winter against the rabbits in the vicinity of all plantations very appreciably lessened the damage. Snaring and shooting have proved the most effective methods of control.

TIMBER

The fiscal year 1935 saw an increase in receipts and quantity of timber cut from the national forests. The cut under timber sales and land exchanges was 752,368,000 board feet, as against 674,541,000 board feet in 1934—an increase of slightly less than 12 percent. The increase in receipts amounted to about \$188,000. Practically no sales were made to supply new milling capacity. With the general strengthening of the demand for lumber, operators of national-forest timber gradually increased their production. A few new sales of moderate size were made to established operators. A liberal policy in the granting of time extensions for the completion of agreements was continued.

Under the provisions of the act of April 17, 1935, it became possible to relieve from certain contractual obligations purchasers of national-forest stumpage who, having obtained their stumpage just prior to the depression, cannot now complete the cutting and removal of the timber. The termination of agreements as authorized by this act removes certain liabilities of the purchasers for damages that jeopardized the continuance of business enterprises, and therefore of opportunities for employment. In some cases the Department had no option, without this legislation, except to bring suit for damages, although this action would almost certainly bring bankruptcies. Several large operators have taken or are taking advantage of this legislation.

With the passing of the National Recovery Administration Lumber Code, lumber prices have softened somewhat. The demand, however, has improved, largely through the placing of orders by Government agencies and through stimulated building as a result of loans under the Home Owners' Loan Corporation.

Work in timber-stand improvement through use of the Civilian Conservation Corps continued. It accomplished a decided improvement in the condition of

stands on hundreds of thousands of acres where growth was stagnated through extreme density, or the better species were being crowded out by faster-growing inferior species, or valuable species were being held back or interfered with by defective residual trees from early logging operations. Work of this type will result in shorter rotations of forest crops, a better quality of timber, and greater yields per acre, which in turn will hasten the time when a systematic sustained yield may be realized, with its attending dividends in permanent, stabilized employment.

While much has been accomplished, there are still millions of acres to be worked; and with the area of national-forest land steadily increasing, the acreage needing treatment is growing rather than diminishing. It is hoped that the work can be continued as a regular activity.

In the more densely populated regions much of the material cut in these cultural operations is available to transportation facilities and is utilized by the local inhabitants for fuel and fencing. In other cases, where some of the trees needing removal contain merchantable material but occur too scatteringly to be sold standing, the merchantable portions can be decked along the roads by the Civilian Conservation Corps workers and sold there. This utilization is encouraged.

Miscellaneous products sales of such things as gum, Christmas trees, wild shrubs, and pine cones aggregated 1,312. The number of small timber sales (transactions involving \$500 or less) was 17,380, and of large sales (transactions involving more than \$500) 140. All three classes of sales showed an increase over 1933. The demand for wood from the national forests for domestic purposes has continued to grow, and people come from long distances to the forests for their wood supplies. This demand for fuel and fencing permits of thinning crowded stands, and rids the forest of dead and down timber which otherwise would add to the fire hazard.

The national-forest timber-sale business for the fiscal year is summarized in tables 7 and 8.

TABLE 7.—Quantity and value of national-forest timber cut under sales, fiscal year 1935

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alaska.....	27,738,000		27,738,000	39,599		39,599
Arizona.....	41,137,000	472,000	41,609,000	96,236	470	96,706
Arkansas.....	23,375,000	408,000	23,783,000	221,310	408	221,718
California.....	100,646,000	1,380,000	102,026,000	250,366	1,037	251,403
Colorado.....	36,923,000	931,000	37,854,000	83,207	824	84,031
Florida.....	4,172,000		4,172,000	14,129		14,129
Georgia.....	2,160,000		2,160,000	6,547		6,547
Idaho.....	64,062,000	4,458,000	68,520,000	197,563	4,098	201,661
Louisiana.....	975,000		975,000	815		815
Maine.....	75,000		75,000	305		305
Michigan.....	5,521,000	2,000	5,523,000	10,564	2	10,566
Minnesota.....	6,671,000		6,671,000	10,705		10,705
Mississippi.....	1,747,000		1,747,000	1,508		1,508
Montana.....	18,591,000	4,016,000	22,607,000	31,019	4,387	35,406
Nevada.....	501,000	159,000	660,000	591	124	715
New Hampshire.....	11,357,000		11,357,000	33,154		33,154
New Mexico.....	6,996,000	868,000	7,864,000	15,360	865	16,225
North Carolina.....	19,461,000		19,461,000	36,940		36,940
Oregon.....	69,324,000	3,139,000	72,463,000	155,171	2,242	157,413
Pennsylvania.....	4,129,000		4,129,000	9,604		9,604
South Carolina.....	1,293,000		1,293,000	4,647		4,647
South Dakota.....	25,458,000	455,000	25,913,000	58,988	448	59,436
Tennessee.....	3,847,000		3,847,000	10,152		10,152
Utah.....	12,317,000	1,925,000	14,242,000	25,958	1,934	27,892
Vermont.....	1,148,000		1,148,000	5,822		5,822
Virginia.....	9,604,000		9,604,000	9,042		9,042
Washington.....	118,242,000	248,000	118,490,000	292,331	197	292,528
West Virginia.....	653,000		653,000	1,756		1,756
Wisconsin.....	1,050,000		1,050,000	1,467		1,467
Wyoming.....	29,667,000	945,000	30,612,000	75,839	907	76,746
Total, 1935.....	648,840,000	19,406,000	668,246,000	1,700,695	17,943	1,718,638
Total, 1934.....	579,789,000	18,962,000	598,751,000	1,380,125	16,620	1,396,745

¹ In addition, minor products not convertible into board feet were cut, the value of which was \$41,140 in 1935 and \$25,783 in 1934.

TABLE 8.—Quantity and value of national-forest timber sold, fiscal year 1935

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alaska.....	32,731,000	-----	32,731,000	46,976	-----	46,976
Arizona.....	79,035,000	534,000	79,569,000	133,606	531	134,137
Arkansas.....	37,041,000	581,000	37,622,000	210,662	581	211,243
California.....	42,643,000	1,196,000	43,839,000	71,800	930	72,730
Colorado.....	25,217,000	826,000	26,043,000	55,569	779	56,348
Florida.....	4,114,000	-----	4,114,000	14,195	-----	14,195
Georgia.....	2,859,000	-----	2,859,000	7,473	-----	7,473
Idaho.....	94,290,000	3,647,000	97,937,000	324,955	3,417	328,372
Louisiana.....	975,000	-----	975,000	815	-----	815
Maine.....	254,000	-----	254,000	684	-----	684
Michigan.....	2,098,000	4,000	2,102,000	4,141	5	4,146
Minnesota.....	3,837,000	-----	3,837,000	6,833	-----	6,833
Mississippi.....	3,657,000	-----	3,657,000	3,208	-----	3,208
Montana.....	22,208,000	4,416,000	26,624,000	43,531	4,282	47,813
Nebraska.....	2,000	-----	2,000	3	-----	3
Nevada.....	473,000	136,000	609,000	452	107	559
New Hampshire.....	21,119,000	-----	21,119,000	70,543	-----	70,543
New Mexico.....	13,529,000	860,000	14,389,000	28,102	862	28,964
North Carolina.....	21,578,000	-----	21,578,000	26,905	-----	26,905
Oregon.....	22,716,000	3,827,000	26,543,000	37,331	2,637	39,968
Pennsylvania.....	2,913,000	-----	2,913,000	8,259	-----	8,259
South Carolina.....	1,377,000	-----	1,377,000	4,761	-----	4,761
South Dakota.....	22,226,000	354,000	22,580,000	65,289	362	65,651
Tennessee.....	6,441,000	-----	6,441,000	11,521	-----	11,521
Utah.....	6,901,000	1,176,000	8,077,000	14,597	1,200	15,797
Vermont.....	666,000	-----	666,000	2,762	-----	2,762
Virginia.....	11,689,000	-----	11,689,000	10,399	-----	10,399
Washington.....	44,442,000	237,000	44,679,000	64,052	190	64,242
West Virginia.....	1,169,000	-----	1,169,000	2,662	-----	2,662
Wisconsin.....	1,807,000	-----	1,807,000	2,307	-----	2,307
Wyoming.....	120,917,000	970,000	121,887,000	262,719	923	263,642
Total, 1935.....	650,924,000	18,764,000	669,688,000	1,537,112	16,806	¹ 1,553,918
Total, 1934.....	441,828,000	20,261,000	462,089,000	1,061,686	18,227	¹ 1,079,913

¹ In addition, minor products not convertible into board feet were sold, valued at \$21,758 in 1935 and \$29,583 in 1934.

PLANTING

In the calendar year 1934, more than 74,000 acres of national-forest land was planted or seeded with trees—approximately an 8-percent increase over the area so treated in 1933. The increase was not as great as was hoped for in view of the availability of emergency labor from Civilian Conservation Corps camps and allotments from the National Recovery Administration. The limiting factor was the quantity of suitable nursery stock available. Experience in 1933 had demonstrated anew the necessity for using young trees of the kind and development adapted to the specific areas to be planted; more than 15,000 acres had to be replanted, largely because of the use of purchased trees which proved to be unsuited to the conditions they encountered. The slower but far more certain method is to determine what should be planted in each case and grow the trees in a nursery for from 1 to 4 years until they meet the particular specifications.

A notable expansion of Forest Service nurseries was made in preparation for planting over 150,000 acres in the calendar year 1935. This expansion was chiefly east of the Great Plains, to make productive previously devastated portions of the newly purchased lands.

The area planted and sown on the national forests during the calendar year 1934 is shown, by States, in table 9.

TABLE 9.—*Planting and sowing on national forests, by States, calendar year 1934*

State	Area planted	Area sown	Total	State	Area planted	Area sown	Total
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>		<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Arkansas.....	1,705.0		1,705.0	New Hampshire.....	141.0		141.0
California.....	1,121.0	340.0	1,461.0	North Carolina.....	266.0		266.0
Colorado.....	3,297.0		3,297.0	Oregon.....	1,356.0		1,356.0
Georgia.....	27.0		27.0	Pennsylvania.....	2,615.0		2,615.0
Idaho.....	2,629.0		2,629.0	Tennessee.....	396.0		396.0
Illinois.....	56.0	468.0	524.0	Vermont.....	750.0		750.0
Louisiana.....	473.0		473.0	Virginia.....	388.0		388.0
Michigan.....	26,997.0		26,997.0	Washington.....	4,603.0		4,603.0
Minnesota.....	3,858.0		3,858.0	West Virginia.....	1,100.0		1,100.0
Mississippi.....	22.0		22.0	Wisconsin.....	20,632.0	59.0	20,691.0
Missouri.....	83.0	13.0	96.0	Wyoming.....	309.0		309.0
Montana.....	122.0		122.0				
Nebraska.....	890.0		890.0	Total.....	73,836.0	880.0	74,716.0

Table 10 shows the present and estimated future capacities of the national-forest nurseries. While they are designed primarily for the production of stock to be planted on the national forests, small amounts of coniferous stock from them will be used to supplement the stock grown by and for the Great Plains shelter-belt project.

TABLE 10.—*Production capacity of the national-forest nurseries*

Location	Nursery	Area	Production capacity in thousands	
			Present	Possible
		<i>Acres</i>		
Arkansas, Russelville.....	Ozark.....	14.9	1,070	3,000
California, Susanville.....	Susanville.....	7.8	540	1,500
Colorado, Monument.....	Monument.....	16.5	2,300	4,300
Louisiana, Alexandria.....	Stuart.....	112.4	10,255	50,000
Michigan:				
Manistee.....	Chittenden.....	80.0	51,350	145,000
East Tawas.....	Beal.....	19.0	12,000	14,000
Manistique.....	Manistique.....	84.0	27,000	17,000
Minnesota:				
Cass Lake.....	Cass Lake.....	19.7	12,785	12,655
Do.....	Lydiack.....	60.0	39,000	41,000
Montana, Haugen.....	Savenac.....	26.0	6,500	10,000
Missouri, Licking.....	Licking.....	25.9	15,000	16,000
Nebraska, Halsey.....	Bessey.....	28.7	2,380	6,050
Washington, Stabler.....	Wind River.....	13.0	2,365	3,000
West Virginia, Parsons.....	Parsons.....	66.0	887	5,000
Wisconsin:				
Park Falls.....	Nepco.....	19.0	14,445	14,000
Rhineland.....	Rhineland.....	55.8	30,145	25,000
Wyoming, Laramie.....	Pole Mountain.....	11.0	225	1,000
Total.....		659.7	228,247	268,505

¹ Present production based largely on 1-0 and 2-0 stock. When production is placed on 3-0 and transplant-stock basis, the amount of stock it will be possible to grow will be reduced.

RANGE

WEATHER AND FORAGE CONDITIONS

The 1934 grazing season on the national forests was one of the worst ever known. In eastern Montana and Wyoming forage dried up so early that eventually about 50 percent of all the livestock was sold to the Government under its drought-relief program. A similar situation prevailed in the Black Hills, where the hay crop was a total failure. In Colorado the 1933-34 winter snowfall was deficient. High ranges turned brown by July, feed was short, and many springs, streams, and ponds went dry, causing a harmful

concentration of cattle near other watering places. Many irrigated fields dried up, there was little fall pasture, and little more than a 50-percent hay crop. On four forests grasshoppers were a serious pest.

In New Mexico and Arizona some areas suffered extreme drought, others received half of the normal precipitation, and a few had normal forage production. Some ranges could not be used at all during the summer. The winter ranges were generally short of feed, so that few young stock were carried over; but fall rains and much snow made prospects good for 1935.

In Idaho, Utah, and Nevada drought and high temperatures resulted in the worst grazing season on record. Many of the lower ranges were dry in April. Forage averaged about 55 percent of normal, after 10 years of drought in which a 50-percent precipitation deficiency had accumulated. In October the desert ranges were in the worst condition in 30 years. In this region, however, the supply of hay and concentrates proved adequate to bring the reduced numbers of stock through the winter in fair condition, and with normal precipitation during the winter grazing prospects were much more favorable for 1935. On April 1, 1935, the Bureau of Agricultural Economics showed ranges 67 percent of normal, cattle 78 percent, and sheep 81 percent.

In California the 1934 precipitation was 29 percent below normal, following several dry seasons. Forest ranges matured from 2 to 6 weeks early, and the volume of forage produced was approximately 70 percent of normal—a little better than in 1933. Most stock remained in good condition until August, but then lost weight rapidly for lack of adequate feed and water. Early fall rains and warm weather changed the winter condition of forage from one of the worst to one of the best that the present generation of stockmen can remember; in some places 1 acre sufficed to support a ewe and lamb until May 1.

In Washington and Oregon many springs and other water supplies heretofore dependable dried up. In general, livestock entered the range in fairly good condition, and many steers and dry cows left in good to excellent condition, but lambs and cows with calves were very commonly under weight.

In the fall the extensive Government purchases of thin cattle relieved the situation in many of the worst drought areas of the West. Stock too poor to ship was slaughtered on the range. These drought relief purchases did much to increase prices during the fall and winter, and to make reductions on overgrazed ranges much easier. In California lambs brought a cent more than in 1933, but elsewhere much the same. Good beef cattle in Montana and Idaho were slightly higher. Winter losses have been light, the seasonal condition of livestock is good or excellent, and improved prices have done much to encourage stockmen. On the other hand, the cumulative effect of several years of drought has been reduced range productivity, localized overgrazing, especially near watering places, acceleration of localized erosion, and disappointing gains in livestock weights. The repetition of adverse conditions year after year emphasizes the necessity of conserving our range resources by reducing grazing allowances, even though this meets with opposition from stockmen.

RANGE USE

The total number of permittees increased 1 percent, the number of cattle allowed to graze under permit nearly 2 percent, and the number of sheep increased very slightly. (See table 11.) In addition to the stock under permits there were grazed in the six western national-forest regions 60,549 cattle and horses and 8,202 sheep and goats under the regulation authorizing free grazing of not to exceed 10 head of stock used for domestic purposes, or by prospectors, campers, and travelers, or in connection with permitted operations on the national forests. A liberal policy of nonuse permits helped many distressed permittees to protect their holdings pending readjustment of their affairs.

TABLE 11.—*Grazing permits issued and numbers of stock allowed under pay permit on the national forests, by States, calendar year 1934*

State	Cattle, horses, and swine				Sheep and goats		
	Permits issued	Stock grazed			Permits issued	Stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Arizona.....	999	193, 210	1, 111	86	94	245, 189	10
Arkansas.....	22	801			1		100
California.....	1, 625	138, 874	3, 656	70	277	355, 954	75
Colorado.....	3, 040	283, 735	2, 121		904	970, 469	80
Florida.....	25	1, 458					
Idaho.....	2, 827	129, 828	4, 689		1, 004	1, 308, 533	
Michigan.....					3	755	
Montana.....	1, 865	125, 108	5, 646		420	600, 051	90
Nebraska.....	41	13, 292	445				
Nevada.....	341	56, 914	1, 627		126	302, 945	
New Hampshire.....	8	113	3				
New Mexico.....	1, 962	92, 923	1, 548	19	277	200, 156	8, 08
North Carolina.....	237	1, 097	5	139	13	117	10
Oklahoma.....	50	2, 143					
Oregon.....	1, 164	86, 120	1, 245		426	601, 616	
Pennsylvania.....	1	15					
South Dakota.....	665	27, 684	743		40	26, 108	
Tennessee.....	57	471	14		3	65	
Utah.....	4, 024	111, 340	3, 006		1, 864	751, 190	
Virginia.....	67	726	4		6	136	
Washington.....	413	14, 592	305		106	142, 940	
West Virginia.....	45	416	10		68	1, 600	
Wisconsin.....	20	394					
Wyoming.....	752	108, 133	3, 371		279	644, 420	
Total, 1934.....	20, 250	1, 389, 387	29, 549	314	5, 911	6, 152, 244	9, 12
Total, 1933.....	19, 863	1, 366, 538	31, 797	533	5, 994	6, 150, 921	11, 04

Permit reductions because of overgrazing in former years and reduced carrying capacity amounted to 358,785 cattle- and horse-months and 645,786 sheep-months. Serious overgrazing due to the drought has necessitated still larger reductions in 1935. The demand for range by old permittees and new applicants far exceeds the range capacity on all the western forests. The livestock industry is so firmly established that stability of range use is adequately assured. Increased demand for national-forest range is due largely to the reduced carrying capacity of State and private lands caused by drought, overgrazing, and erosion, to better livestock prices, and to low national-forest grazing fees as compared with the charges made for private ranges of similar capacity. The curtailment of outside stock on Indian reservations and on some State and railroad lands through reductions for protection have increased in some cases by 50 percent the demand for national-forest range.

Term permits.—Table 12 shows the 1934 situation with respect to term permits. All these permits expired December 31, 1934. Term permits have led to more personal interest on the part of some permittees in their own allotments, and to more stability in their individual ranch operations, but they have also restricted action which drought and other conditions justified and have led to speculation in grazing preferences and in overcapitalization of outfits. Since unusual conditions, social, economic, and physical, demand more flexibility in grazing administration, no new 10-year permits should be issued at present. This course is necessary to restore range carrying capacity seriously lowered by overgrazing during several years of subnormal precipitation; to reduce to the minimum erosion, with its resultant silting of ditches, canals, and reservoirs; and to provide opportunity for wider distribution of grazing privileges in the light of existing conditions and local community needs.

TABLE 12.—*Livestock allowed under term or 10-year permits on the western national forests, calendar year 1934*

Region	Stock under term permits			
	Cattle and horses		Sheep and goats	
	Number	Percent	Number	Percent
1.....	60, 168	41	239, 486	33
2.....	167, 223	41	652, 702	47
3.....	149, 098	48	256, 538	56
4.....	275, 792	77	2, 198, 805	87
5.....	45, 600	31	104, 755	29
6.....	23, 025	22	323, 251	42
Total 1934.....	720, 908	49	3, 775, 537	61
Total 1933.....	720, 177	40	3, 840, 887	62

Social welfare demands a partial redistribution of grazing privileges looking toward the establishment of a greater number of economically sound livestock home units. These will necessarily vary considerably in size in different parts of the country. In the interest of the greatest permanent good for the largest number of deserving stockmen, several years will be required to work out equitable range adjustments which will give a greater number of ranch families an opportunity to earn a decent living. For thousands of small farmers and ranchers the opportunity to increase their herds by securing a permit to run a few head of cattle or sheep on national-forest range, or slightly to increase the number already there, may mean the difference between success and failure; between paying off their mortgages or losing their homes, between keeping their families on a subsistence basis or slowly building up ranch homes that will be a credit to the community and a fitting place in which to rear children to intelligent, worth-while citizenship.

In any small business with a fixed overhead expense a small additional income may prevent failure. During these distressing years of drought, low prices, and financial difficulties, doubtless thousands of owners of ranch homes have lost their ranches who would have won out if a part of their stock could have grazed on national-forest range. In 1934 more than 31,000 families on the national forests were on relief rolls, and a like number in communities adjacent to the forests. It is apparent that careful study should be made of the extent to which range use may supplement ranch incomes to sustain homes.

Four percent of the sheep permittees now graze 22 percent of the sheep, and 7 percent of the cattle permittees graze 44 percent of the cattle. On one forest 16 permittees graze 105,000 sheep, while hundreds of small farmers in the valley are clamoring for national-forest privileges necessary to maintain small-farm flocks. Other striking examples could be quoted. Unusual financial and weather conditions have in many cases worked to the disadvantage of the small ranch owner and have increased the holdings of the larger outfits. Widespread unemployment emphasizes how essential it is to encourage and develop a maximum number of economically sound livestock home units and thus help to build up progressive communities. A further study of the distribution of range privileges is of paramount importance.

ADVISORY BOARDS

Cooperation with users is essential to successful administration. This is proved by 30 years of practical experience, dealing with over 700 livestock associations. Cooperation has its definite and important field. Stockmen should not finally decide, nor do they expect to do so, such vital questions as who should use the range, the number of stock to be allowed, the season of use, or the adjustment of privileges to meet varying public needs. These questions concern public interest. There are, however, questions relating purely to the care and management of livestock which concern individual interests and should be left to the advisory boards. Their ability, willingness, and spirit of fair

dealing in handling questions of this kind have been well demonstrated. The results of past cooperative efforts with advisory boards lead to the inescapable conclusion that the present course should continue to be followed by the Forest Service.

TRESPASSING STOCK

The number of trespassing wild horses decreased 19 percent, or from 9,201 in 1933 to 7,414 in 1934. Trespassing cattle and horses showed an increase of 3,650, or 25 percent, primarily because of drought-stricken ranges, partly because through mortgages many cattle owners lost their stock and were unable to pay their grazing fees. Trespassing sheep increased from 59,738 to 66,495, an increase of 11 percent over the number in 1933, largely because sheepmen were almost desperate in their efforts to secure sufficient feed for their flocks. While larger numbers of stock trespassed, in terms of animal-months the amount of trespass was actually reduced.

RANGE SURVEYS AND MANAGEMENT

During 1934, 7,832,117 acres were covered by intensive range surveys, bringing the total to 68,668,173 acres. In no other country have so extensive range surveys and so comprehensive range management and land utilization plans been conducted and put in operation as in the long-time land-use plans of the Forest Service. It is plain that the application of these scientific studies by trained men of practical experience will have a cumulative beneficial effect which it is impossible to overestimate. A series of dry years has served to emphasize the necessity for complete management plans for all of the 9,153 separate range allotments, of which 7,511 now have completed plans. In no other way can maximum production of forage be secured, overgrazing and erosion prevented, and an equitable distribution of range among permittees effected. Since on most forest ranges more than one resource is involved, management plans determine the best correlated use of the land.

Low cattle prices have made it increasingly difficult to get livestock associations to hire riders for the efficient handling of cattle.

Table 13 shows the construction of range improvements during the fiscal year 1934. Labor furnished by Civilian Conservation Corps enrollees was valued at \$546,000 and local labor on relief rolls at \$827,000. Expenditures for equipment and supplies also added much labor and other income directly and indirectly to local communities. With 31,013 families and 19,389 laborers residing within national forests on relief rolls in 1934, and a similar number on lands adjoining the forests, it is easy to see the part played by range improvement construction in keeping men off a direct dole. The 3,785 miles of fence, 81 corrals, 596 driveways, 53 bridges, and 1,972 water developments constructed in 1934 will make available much isolated and inaccessible range and will prevent overgrazing on other areas. The improvements constructed during the last 2 years have added to the value of grazing permits, and will have great value for many years to come.

TABLE 13.—*Number and cost of range improvements constructed on national forests, fiscal year 1934, with emergency relief funds*

Region	Fences		Corrals		Driveways		Bridges		Water developments		Miscellaneous cost	Total cost
	Miles	Dollars	Number	Dollars	Miles	Dollars	Number	Dollars	Number	Dollars	Dollars	Dollars
1.....	322	197,024	6	739	113	13,150	10	1,397	295	45,710	9,334	267,35
2.....	520	431,175	8	7,614	127	10,299	4	540	264	290,027	38,009	777,66
3.....	2,022	649,558	12	2,766	7	1,121	-----	-----	401	161,036	133,514	947,99
4.....	303	194,929	19	5,081	68	27,031	27	7,153	459	85,190	54,528	373,91
5.....	194	73,097	3	922	25	8,419	-----	-----	188	33,374	56,917	172,72
6.....	334	116,740	32	6,114	256	13,795	12	4,047	328	25,691	12,703	179,09
8.....	90	26,909	1	360	-----	-----	-----	-----	37	1,202	-----	28,47
Total:												
1934..	3,785	1,689,432	81	23,596	596	73,815	53	13,137	1,972	642,230	305,005	2,747,21
1933..	615	130,531	34	4,567	79	5,940	5	4,852	516	57,844	23,647	227,38

Table 14 shows the losses of livestock on the national forests during the calendar year 1934. As in last year's report, cattle and horses were valued at \$30 per head, and sheep and goats at \$5. The shortage of feed caused greater losses from eating poisonous plants than in any recent year. Pro-

tracted droughts have not only curtailed the production of palatable forage but also, by leaving ground bare, have favored the spread of poisonous plants. These continue to be the greatest cause of cattle and horse losses, and predatory animals the greatest cause of sheep and goat losses.

TABLE 14.—*Livestock losses, 1934*

CATTLE AND HORSES

Region	From poisonous plants		From predatory animals		From disease		From other causes		Total	
	Number	Value	Number	Value	Number	Value	Number	Value	Number	Value
1-----	311	\$9,330	23	\$690	78	\$2,340	472	\$14,160	884	\$26,520
2-----	2,779	83,370	107	3,210	943	28,290	1,621	48,630	5,450	163,500
3-----	543	16,290	1,096	32,880	945	28,350	5,217	156,510	7,801	234,030
4-----	2,088	62,640	138	4,140	251	7,530	1,815	54,450	4,292	128,760
5-----	419	12,570	66	1,980	172	5,160	886	26,400	1,537	46,110
6-----	207	6,210	33	990	157	4,710	466	13,980	863	25,890
Totals 1934..	6,347	190,410	1,463	43,890	2,546	76,380	10,471	314,130	20,827	624,810
Total 1933..	5,934	178,020	1,179	35,370	2,718	81,540	7,994	239,820	17,825	534,750

SHEEP AND GOATS

1-----	3,052	\$15,260	7,523	\$37,615	1,501	\$7,505	8,416	\$42,080	20,492	\$102,460
2-----	12,009	60,045	14,294	71,470	3,368	16,840	14,040	70,200	43,711	218,555
3-----	2,871	14,355	2,454	12,270	1,252	6,260	3,052	15,260	9,629	48,145
4-----	10,115	50,575	39,069	195,345	5,224	26,120	20,129	100,645	74,537	372,685
5-----	1,805	9,025	4,637	23,185	656	3,280	4,767	23,835	11,865	59,325
6-----	4,225	21,125	10,800	54,300	3,110	15,550	11,803	59,015	29,998	149,990
Totals 1934..	34,077	170,385	78,837	394,185	15,111	75,555	62,207	311,035	190,232	951,160
Total 1933..	25,693	128,465	66,409	332,045	12,563	62,815	56,481	282,405	161,146	805,730

Apparently predatory animals have increased as appropriations to the Bureau of Biological Survey have been cut down and the number of trappers and hunters reduced. It should be noted that the bedding-out system of sheep management is most efficient in forage utilization, in putting gains on sheep and lambs, and in preventing overgrazing and damage to the range. An increase in the number of predatory animals adds much to the difficulty of this system of management and greatly increases the losses. Losses from disease and inclement weather were increased by inadequate feed supplies, which reduce animal resistance. While the aggregate loss, from all causes, of approximately 190,000 sheep and goats and 21,000 cattle and horses amounted to only 3 percent of the sheep and 1½ percent of the cattle, their money value, more than \$1,500,000, would go a long way toward removing the causes, were its equivalent available for the purpose.

In many instances the dry weather has intensified the ravages of increasing numbers of rodents, which have done wide-spread and serious damage to the range. Fewer hawks, owls, coyotes, badgers, weasels, and other small animals of prey probably have contributed to this increase. Rodent-control work, in cooperation with the Bureau of Biological Survey, the Civilian Conservation Corps, and public-relief programs, has been very valuable and will add much to the carrying capacity of the ranges on which this work has been done. The national-forest range area treated during 1934 was 4,006,946 acres; the area now infested is 13,353,809 acres.

RECREATION AND WILDLIFE

Occurring as they do in almost three-fourths of all the States and embracing more than one-twelfth of the entire land area of the 48 States, the national forests are within convenient motor travel of the greater part of the population and constitute the major publicly owned areas available for outdoor recreational use. While approximately 10,000,000 acres are being maintained in relatively inaccessible condition in order to preserve their primitive qualities, by far the major part of the national forests is now readily accessible. Through the expenditures for the Civilian Conservation Corps and other work-relief projects the development of an extensive network of well constructed and maintained

roads and trails has been rapidly advanced. Except where exclusive privileges are desired, recreational use of the national forests is allowed without permit or charge, conducted with a minimum of restriction and supervision, and subject only to the restrictions essential to the protection of public health and property. In these circumstances it is but natural that many millions of people should regard the national forests as fully satisfying their requirements for various forms of outdoor recreation.

Increasing attention was given during the year to the formulation of plans of land use under which recreational occupancy could be most effectively harmonized with other uses and purposes of the national forests, and through which the areas of more than normal value for such forms of use could be so developed that they would yield optimum returns in human satisfaction, mental and physical development, and good citizenship. Previous inventories and classifications were carefully reviewed, and earlier project plans were reconsidered in the light of new human requirements, dominant economic considerations, and administrative needs. The progress made will guarantee that future recreational use of the national forests will be satisfying, well-ordered, and richly productive of social values. It will also afford the hundreds of towns and villages within or close to the national forests new means of economic life to supplement such industries as grazing, mining, and stock growing.

In all of the emergency-employment activities conducted within the national forests, the place and part of recreational use was definitely recognized. Hazard removal, roadside clean-up, planting, and like phases of the emergency work were in large measure influenced by the objective of preserving or enhancing esthetic values. With the man-power available it also was possible to establish on many new camp grounds the facilities requisite to the protection of public health and property, and to improve greatly the standard and quality of these facilities upon many of the camp grounds previously partially equipped. At the close of the fiscal year the total number of improved camp grounds was 3,016, a gain of 787 over the number the preceding year. The facilities provided make a strong appeal to most of the visitors, induce their voluntary concentration in areas of minimum hazard to public health and property, and thus in large measure make unnecessary any fear that the increasing occupancy of the national forests by summer visitors may adversely affect the public properties or interests. In certain limited areas and during periods of extreme fire risk the exclusion of the public is required, but in the main the national forests may be used during the vacation period without limitation.

During the year 3 primitive areas were established with an aggregate area of 1,438,230 acres, bringing the total number to 71 and the total area to 11,378,411 acres. Classification as a primitive area does not wholly withdraw all natural resources of the area from industrial utilization, but it does guarantee that there shall be no unnecessary modification of natural conditions or impairment of the scientific, educational, and inspirational values.

The estimated number of persons visiting or passing through the national forests during the fiscal years 1934 and 1935 is shown below.

	1934	1935
Summer-home owners and guests.....	613, 495	727, 637
Hotel and resort guests.....	1, 014, 008	1, 268, 998
Campers.....	2, 343, 132	2, 395, 658
Picnickers.....	4, 610, 171	5, 326, 037
Visiting motorists, horsemen, hikers, etc.....	4, 646, 086	7, 104, 686
Motorists en route elsewhere.....	24, 836, 206	41, 725, 001

Motorists of the last class, though their travel through the forests may be undertaken for purposes unrelated to the recreational opportunities along the way, incidentally enjoy the benefit of the scenic protection and provision for their needs and pleasurable passing through which national-forest administration secures. That facilities for motor travel, of which touring forms so large a part, should be constructed and maintained with due regard for aesthetic enjoyment is now a truism. In estimating the number of visiting and transient tourists, attempt is made to allow for repeated visits by the same person and for tourist travel through several forests on the same trip; but undoubtedly the record includes more or less duplication. The estimated total number making use of the national-forest recreational opportunities last year reached the incredible peak of 58 548,017.

The past year has marked an increased public interest in wildlife. This has been manifested in legislative action, both Federal and State, in the National Resources Board report, in increased demands on the part of conservation organizations for better administration, and in enlarged research programs. The Federal Government, the largest owner of land suited to the production of wildlife, must take the leadership in putting its land in a productive condition. The national forests are unique in this respect. They contain the range and an ample breeding stock. With over a million big-game animals, a variety of upland-game birds, and a nucleus of fur bearers, their potentialities are now becoming fully appreciated. In consideration, however, of the enormous area, the problems of effectively coordinated plans of use are far too great for a field organization already overburdened with emergency work and increased administrative responsibilities.

The paramount need is a trained personnel large enough to meet the responsibilities which the public expects the Forest Service to assume. The problem is better visualized by the fact that more than 80 million acres in the national forests, including those in Alaska, and unused by domestic livestock are capable of producing some species of wildlife. Every area has conditions and problems peculiar to itself. No systematic plan can be fully developed until these conditions have been carefully studied and surveyed. The work calls for a personnel equipped with special training in the field of the biological sciences, the development and application of management plans properly integrated with other resource plans, and an active and enlarged protective force. Its magnitude emphasizes the need of coordinating the forces of all interested agencies, Federal, State, and private. Jurisdictional questions must be subordinated to whatever is in the interest of wildlife. Not only must forces be combined, but selfish and political considerations must be eliminated.

Table 15, while indicative of the numbers and species of big-game animals and the estimated increase or decrease over the number in previous years, falls far short of illustrating the potentialities.

TABLE 15.—Number of big-game animals on national forests, by States, estimated as of Dec. 31, 1934

State	Antelope	Bear		Deer	Elk	Moose	Mountain goats	Mountain sheep
		Black or brown	Grizzly					
Alabama.....				750				
Alaska.....		6,200	14,500	47,500	50	520	5,220	1,525
Arizona.....	5,040	790	7	91,050	4,721			188
Arkansas.....		8		2,710				
California.....	2,220	11,431		256,950	121			442
Colorado.....	224	3,362	3	59,570	15,276			3,002
Florida.....		180		4,350				
Georgia.....		3		450				
Idaho.....	4,116	4,999	55	63,597	11,706	597	3,463	1,591
Louisiana.....				271				
Maine.....		23		200				
Michigan.....		515		18,964	7	106		
Minnesota.....		1,655		14,700	10	2,470		
Mississippi.....				113				
Montana.....	1,106	5,642	455	55,777	20,420	1,955	4,190	1,581
Nebraska.....				167				
Nevada.....	220	2		11,253	60			170
New Hampshire.....		430		2,158				
New Mexico.....	930	1,275	3	97,400	1,302			106
North Carolina.....		568		3,737	15			
Oklahoma.....		4		1,000	345			
Oregon.....	430	5,621		88,607	13,068			56
Pennsylvania.....		247		26,758	15			
South Carolina.....		50		2,010				
South Dakota.....	12			5,055	222		16	
Tennessee.....		83		465				
Utah.....	100	601	4	80,860	3,186			159
Vermont.....		25		400				
Virginia.....		439		1,034	20			
Washington.....		8,221	6	36,343	9,308		5,073	6
West Virginia.....		683		1,950				
Wisconsin.....		307		35,052	1	1		
Wyoming.....	615	1,753	139	27,215	40,785	2,478		4,025
Total, 1934.....	15,013	55,122	5,172	1,038,416	126,638	8,127	17,962	13,145
Total, 1933.....	14,453	55,840	5,221	938,332	115,197	8,084	20,183	12,150

¹ Includes Alaska brown bear.

WATER POWER

The year brought no striking developments in the utilization of the water-power resources of the national forests. The increase in use of electric energy is gradually eliminating such surplus generating capacity as has existed, but on the whole the effect hitherto on additional water power construction in the national forests has been slight. In several sections of the West steam power generated from oil and gas still is preferred to water power.

The Forest Service, acting for the Federal Power Commission, was supervising the operations of 381 permittees or licensees at the end of the year, as against 379 a year earlier. One valuation report was made. During the year 29 applications for permits or licenses involving the use of national-forest land, or 6 more than during the preceding year, were received by the Commission. This was 69 percent of the total number of applications filed under the provisions of the Federal Water Power Act during the fiscal year.

On June 30, 1935, 205 permits issued by the Department of Agriculture, through the Forest Service, prior to the Federal Water Power Act were still in effect. Of these, 97 were permits or easements for water-power projects, with a total low-flow output of 456,717 horse power; or an average of 4,708 horsepower per permit or easement. The remaining 108 were for transmission lines only; their length within the national-forest boundaries was 965.50 miles. Of the power projects 51, with an estimated low-flow output of 431,607 horsepower, and of the transmission line cases 88, with a length of 809.02 miles within the forest boundaries, required the payment of an annual rental for the use of the national forest land. The estimated average output of power projects for which no rental was required was 25,110 horsepower, and the length within the national-forest boundaries of the similar transmission lines was 156.48 miles.

ROADS AND TRAILS

The transportation system as planned for the national forests is shown in table 16. The forest highways are roads required primarily for public travel, while the forest-development roads and trails are primarily for the protection administration, development, and utilization of the forests. Tables 17, 18, and 19 show, by States, the miles constructed and maintained and the expenditures and apportionments of the various road funds; and table 20 shows the condition of these funds at the close of the fiscal year.

TABLE 16.—*Classification of mileage in forest road and trail system and expenditure required to complete the system to a satisfactory standard, June 30, 1935*

Class	Total	Satisfactory standard	Unsatisfactory standard	Nonexisting	Expenditure required to complete
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Dollars</i>
Forest highways.....	20,924	10,302	9,213	1,409	157,181,200
Forest-development roads.....	100,024	43,076	26,561	30,387	83,085,000
Total.....	120,948	53,378	35,774	31,796	240,266,200
Trails.....	153,643	121,187	15,772	16,684	4,870,100
Total.....					245,136,300

TABLE 17.—Construction, improvement, and maintenance of roads and trails from forest road appropriations and other Federal and cooperative funds, by States, June 30, 1935

State	Fiscal year 1935				Total to June 30, 1935		Expenditures to June 30, 1935		
	Miles constructed		Miles maintained		Miles constructed		Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails	Roads	Trails			
Ala.			112.3		117.3		\$790,903.09	\$25,278.16	\$816,181.25
Alaska	20.5	100.9	248.1	523.0	275.3	866.8	8,071,144.85	329,262.27	8,400,407.12
Ariz.	277.2	59.0	4,239.8	2,548.0	3,261.3	2,128.1	13,007,316.09	1,211,987.45	14,219,303.54
Ark.	329.0		1,411.0	923.0	1,496.9	571.4	5,412,856.86	135,929.75	5,548,786.61
Calif.	1,602.5	339.4	14,126.6	21,718.8	9,683.9	12,233.6	41,331,338.94	8,603,946.53	49,925,285.47
Colo.	130.8	188.7	1,351.1	10,829.1	1,929.2	12,077.6	13,113,275.40	1,153,306.18	14,266,581.58
Fla.	95.4		962.1		1,124.6		1,712,693.37	146,179.84	1,858,873.21
Ga.			302.8	275.1	316.9	359.9	2,198,645.12	82,949.62	2,281,594.74
Idaho	1,183.3	435.3	5,185.5	23,285.7	5,630.9	22,216.9	31,529,905.76	1,902,660.14	33,432,565.90
Ill.	102.3		151.0		152.5		1,177,036.81		1,177,036.81
Kans.					3.4		2,111.51		2,111.51
Ky.	52.4		21.0		93.9		936,230.79		936,230.79
La.	72.6		303.0		383.1		503,438.37		503,438.37
Maine	1.0	3.4	13.0	22.7	13.0	89.9	316,956.69		316,956.69
Md.							70.05		70.05
Mich.	707.2		1,664.8	10.0	1,861.8		2,170,348.68	103,174.13	2,273,522.81
Minn.	278.6	83.2	730.3	78.6	979.6	696.9	2,425,105.01	295,469.78	2,720,574.79
Miss.	272.7		392.7		411.7		1,845,409.22		1,845,409.22
Mo.	178.5		349.3		369.5		1,302,817.94		1,302,817.94
Mont.	274.3	78.4	1,237.0	21,330.0	2,116.4	19,551.5	17,254,351.20	665,362.20	17,919,713.40
Nebr.	44.9		78.3		115.1		176,101.69	990.80	177,092.49
Nev.	36.3	3.5	422.4	1,799.5	656.3	940.9	2,953,781.50	171,008.04	3,124,789.54
N. H.	4.8	55.4	100.1	687.2	102.6	742.6	1,646,543.21	95,949.70	1,742,492.91
N. J.							217.71		217.71
N. Mex.	391.2	33.5	2,356.3	3,308.5	2,164.4	1,717.3	9,683,929.03	333,957.32	10,017,886.35
N. Y.							81.32		81.32
N. C.	105.8	13.8	472.3	723.4	491.4	721.4	3,525,485.45	476,954.15	4,002,449.60
N. Dak.					1.0		57.75		57.75
Okla.	27.4		115.0	1.5	102.3	16.5	506,254.33	16,186.08	522,440.41
Oreg.	662.9	528.8	10,995.5	15,760.0	6,862.6	9,817.5	28,827,856.88	8,171,854.51	36,999,711.39
Pa.	32.2	51.9	217.3	250.8	173.6	250.8	1,843,533.77	42,185.50	1,885,719.27
P. R.	9.0	17.0	2.0	17.0	16.5	54.8	581,052.86	550.00	581,602.86
S. C.	118.6		192.4	18.2	192.7	18.2	864,113.35	15,659.81	879,773.16
S. Dak.	38.1	15.0	240.0	40.5	440.0	100.1	1,807,622.01	241,605.27	2,049,227.28
Tenn.	45.0	13.0	267.2	699.8	373.6	696.8	2,926,776.13	197,596.61	3,124,372.74
Tex.	97.8				97.8		402,859.75		402,859.75
Utah	354.0	88.3	1,410.2	4,601.3	2,096.1	3,963.6	7,800,936.48	1,023,310.37	8,824,246.85
Vt.	6.2	26.0	23.4	39.2	13.4	39.2	293,092.39		293,092.39
Va.	65.3	40.0	531.0	515.2	482.1	688.0	2,754,698.47	107,195.35	2,861,893.82
Wash.	490.8	949.8	3,517.7	14,412.0	3,074.6	9,882.2	18,683,394.32	1,730,906.97	20,414,301.29
W. Va.	153.2	74.0	360.9	573.4	528.0	679.2	2,134,688.25	38,159.30	2,172,847.55
Wis.	385.3		649.6		983.0		1,471,073.22	1,820.00	1,472,893.22
Wyo.	93.0	62.6	1,033.6	5,853.7	1,335.8	2,682.9	8,190,572.37	406,632.25	8,597,204.62
Total	8,740.1	3,260.9	55,786.6	130,845.2	50,524.1	103,806.6	242,166,677.99	27,728,038.03	269,894,716.07

TABLE 18.—Distribution among the States of the road and trail apportionments for the fiscal year 1936

State	10-percent fund	Forest high-ways	Forest road development	Total
Alabama	\$7.40	\$6,347	\$8,211	\$14,565.40
Alaska	5,237.27	665,775	20,160	691,172.27
Arizona	20,105.38	419,453	133,416	572,974.38
Arkansas	23,875.83	77,293	54,164	155,332.83
California	56,301.23	1,017,952	578,314	1,652,567.23
Colorado	32,226.08	526,264	125,812	684,302.08
Florida	4,078.69	33,176	12,539	49,793.69
Georgia	1,409.86	16,543	17,347	35,299.86
Idaho	37,368.28	735,550	483,508	1,256,426.28
Illinois		4,384	14,898	19,282.00
Kentucky		5,761	11,530	17,291.00
Louisiana	122.98	11,063	7,189	18,374.98
Maine	214.88	2,195	1,106	3,515.88
Michigan	1,003.70	43,912	87,725	132,640.70

TABLE 18.—*Distribution among the States of the road and trail apportionments for the fiscal year 1936—Continued*

State	10-percent fund	Forest high-ways	Forest road development	Total
Minnesota.....	\$1,640.38	\$71,757	\$44,100	\$117,497.38
Mississippi.....	227.34	23,500	15,000	38,727.34
Missouri.....		17,640	28,638	46,278.00
Montana.....	15,222.25	576,332	237,314	828,868.25
Nebraska.....	662.96	6,921	5,763	13,346.96
Nevada.....	6,377.26	131,537	13,904	151,818.26
New Hampshire.....	3,245.34	38,430	14,375	56,050.34
New Mexico.....	10,238.74	294,338	111,384	415,960.74
North Carolina.....	3,702.91	24,920	21,224	49,846.91
Oklahoma.....	1,353.15	6,023	8,937	16,313.15
Oregon.....	22,880.16	954,042	344,208	1,321,130.16
Pennsylvania.....	1,168.50	17,731	14,681	33,580.50
Puerto Rico.....	57.75	1,045	830	1,932.75
South Carolina.....	322.10	13,299	8,000	21,621.10
South Dakota.....	7,304.15	56,563	36,441	100,308.15
Tennessee.....	1,174.40	21,224	19,979	42,377.40
Texas.....		15,278	8,000	23,278.00
Utah.....	15,916.40	239,010	62,555	317,481.40
Vermont.....	494.43	5,098	4,382	9,974.43
Virginia.....	1,464.97	26,750	24,884	53,098.97
Washington.....	32,796.33	523,812	210,843	767,451.33
West Virginia.....	297.25	23,050	31,104	54,451.25
Wisconsin.....	223.41	31,266	75,919	107,408.41
Wyoming.....	18,332.08	314,766	101,616	434,714.08
TOTAL.....	327,053.84	7,000,000	3,000,000	10,327,053.84

TABLE 19.—*Distribution among the States of the total road and trail apportionments, including the fiscal year 1936*

State	10-percent fund	Section 8	Federal forest road construction	Forest highways ¹	Forest road development ²	Improvement ³	Total
Alabama.....	\$1,053.31	\$15,456.04	\$1,922.31	\$86,744	\$149,689	\$31,077.06	\$285,941.72
Alaska.....	180,818.15	470,963.60	203,229.50	7,982,026	349,434		9,186,471.25
Arizona.....	721,599.18	677,956.45	490,434.11	6,619,848	2,275,203	546,273.39	11,331,314.13
Arkansas.....	168,303.16	175,126.19	128,423.38	1,011,858	959,162	295,897.47	2,738,770.20
California.....	1,841,974.57	1,464,333.82	1,201,431.20	15,959,617	8,313,193	1,518,217.76	30,298,767.35
Colorado.....	881,888.33	770,948.34	784,259.55	7,886,989	2,490,857	197,297.57	13,012,239.79
Florida.....	52,170.69	119,528.14	21,534.94	358,032	221,539	140,417.47	913,222.24
Georgia.....	15,310.62	52,393.57	130,443.73	225,345	342,274	133,229.53	898,996.45
Idaho.....	1,084,267.16	1,176,750.85	1,337,004.17	11,748,003	9,720,998	1,827,886.55	26,894,909.73
Illinois.....				26,239	20,445		46,684.00
Kansas.....	1,867.27						1,867.27
Kentucky.....	722.72			33,906	145,510		180,138.72
Louisiana.....	211.65			52,531	73,135	38,132.47	164,010.12
Maine.....	4,370.18	32.41	3,738.77	32,663	39,078	21,909.56	101,791.92
Maryland.....	70.05						70.05
Michigan.....	6,457.86	115.63	3,000.00	268,720	475,841	164,507.86	918,642.35
Minnesota.....	47,573.51	8,036.36	108,352.03	805,159	612,348	130,348.59	1,711,817.49
Mississippi.....	266.21			82,627	118,399	8,598.45	209,890.66
Missouri.....				48,291	48,841		97,132.00
Montana.....	658,655.28	762,523.77	764,035.26	9,289,599	4,637,436	651,377.24	16,763,626.55
Nebraska.....	21,984.17	18.98		111,952	56,661	578.27	191,194.42
Nevada.....	203,457.80	192,989.88	81,491.85	2,174,266	207,151	45,878.18	2,905,234.71
New Hampshire.....	59,064.91	7,165.35	10,941.30	489,311	274,121	56,487.05	897,090.61
New Jersey.....	118.99				83		201.99
New Mexico.....	390,246.20	426,086.04	518,426.97	4,773,225	1,800,217	408,824.28	8,317,025.49
New York.....	4.00				20		24.00
North Carolina.....	47,476.83	86,336.41	176,466.28	356,185	734,707	192,530.92	1,593,702.44
North Dakota.....	45.75	7.00					52.75
Oklahoma.....	12,992.57	65.49	2,775.17	73,662	191,579	35,700.19	316,774.42
Oregon.....	1,122,317.38	1,428,785.95	1,013,981.59	14,442,070	7,025,908	876,916.07	25,909,978.99

¹ Includes \$3,000,000 appropriated for emergency highways within National forests, fiscal year 1931; \$5,000,000 emergency forest highways, fiscal year 1933; and \$14,600,000 for forest highways under the provision of sec. 205 of the National Industrial Act.

² Includes \$10,000,000 truck trails and trails appropriated under the provisions of sec. 205 of the National Industrial Act, fiscal year 1934, \$109,000 fiscal year 1935, and \$3,000,000 forest road development emergency construction.

³ Includes actual road and trail expenditures made from annual funds.

TABLE 19.—*Distribution among the States of the total road and trail apportionments, including the fiscal year 1936—(Continued)*

State	10-percent fund	Section 8	Federal forest road construction	Forest highways	Forest road development	Improvement	Total
Pennsylvania.....	\$7,840.97	\$7,724.04	\$21.42	\$177,628	\$247,507	\$79,976.40	\$520,697.83
Puerto Rico.....	208.19	7.00	3,343.09	13,798	29,665	4,714.52	51,735.80
South Carolina.....	3,812.33	402.10	48,028.61	67,699	80,666	171.08	206,779.12
South Dakota.....	206,243.31	87,106.45	78,652.52	880,445	371,195	33,879.18	1,657,521.46
Tennessee.....	23,152.50	106,854.56	27,967.79	291,671	401,185	100,304.31	951,135.16
Texas.....				35,982	11,000		46,982.00
Utah.....	470,387.07	464,918.34	512,489.56	3,892,197	1,134,498	183,090.76	6,657,580.73
Vermont.....	981.90			22,754	58,593	10,778.15	93,107.05
Virginia.....	50,584.28	58,390.16	71,784.23	380,201	485,565	154,268.85	1,200,793.55
Washington.....	782,521.37	958,090.33	732,302.49	8,001,128	5,141,966	862,891.32	16,478,839.51
West Virginia.....	6,805.00	12,830.41	5,049.24	190,696	332,937	208,604.94	806,972.59
Wisconsin.....	344.77			140,110	299,027	98,415.88	537,897.65
Wyoming.....	515,953.82	468,056.34	538,468.91	5,066,823	1,666,377	102,815.87	8,358,494.94
TOTAL.....	9,594,124.01	10,000,000.00	9,000,000.00	104,100,000	51,600,000	9,161,997.19	193,456,121.20

TABLE 20.—*Condition of forest-road funds on June 30, 1935*

Fund	Appropriations	Expenditures	Balance
Ten-percent.....	\$9,266,485.15	\$3,673,378.27	\$593,106.88
Section 8.....	10,000,000.00	10,000,000.00	
Federal forest road construction.....	9,000,000.00	9,000,000.00	
Forest highways ¹	81,917,400.00	76,966,629.87	4,950,770.13
Forest highways—N. R. A.....	14,600,000.00	12,801,733.93	1,798,266.07
Forest road development ¹	38,560,000.00	37,422,479.56	1,077,520.44
Forest road development—N. R. A.....	10,100,000.00	9,807,018.38	292,981.62
Improvement ¹	9,161,997.19	9,161,997.19	
Total.....	182,545,882.34	173,833,300.20	8,712,582.14

¹ Includes emergency funds.² Includes \$2,754.82 returned to the Treasury.

The Civilian Conservation Corps accomplished considerable truck-trail and trail construction. From camps located on the national forests 6,402 miles of truck trails and 933 miles of trails were constructed, and 24,979 miles of the former and 13,801 of the latter were maintained. This helped considerably toward completing the planned road and trail system of the national forests and maintaining the truck trails and trails to a more satisfactory standard.

There was available from the Public Works Administration \$9,800,000 for forest highways and \$3,838,000 for the development system. These funds were expended in the same manner as the regular forest-highway and forest-development funds. The latter is practically all expended, and the former will be expended during the present fiscal year.

MAPS AND SURVEYS

The Forest Service compiled, traced or revised, and had published for official use twenty-seven ¼-inch-scale administrative maps and seventeen ½-inch-scale administrative maps. In addition there were published the following: State maps of Oregon and Washington, each in four parts on a ¼-inch scale; two California quadrangles showing vegetation types in colors; an index map of region 3 (Southwestern region) in colors, scale 1 inch equals 20 miles; a map of the Prescott National Forest, Ariz., to accompany an Executive order; and 48 miscellaneous small maps, charts, tables, graphs, and illustrations.

Survey mapping projects were completed on approximately 2,767 square miles of the national forests in the Western States, to the accuracy and scale required to meet the needs of forest administration. In the Eastern and Southern States 8,944 square miles of drainage mapping by the aerial method was completed in connection with the acquisition of new forest units, and in the Superior National Forest in Minnesota, approximately 3,500 square miles of drainage mapping was done by the same methods.

RESEARCH

Forest research is vitally important for the broad development of forestry necessary to meet the demand of the present day, and still more, the demand of the near future. The problems arising in connection with the use of the western forest ranges, those having to do with satisfactory low-cost housing, the need to find new ways of using land and employing labor in the South and elsewhere as the changes in agricultural requirements sap the old-time economic structure, the complex problems of the forest industries, the relationships between forest and water conditions, and the unexplored possibilities in connection with forest genetics, merely illustrate the fields in which research should be seeking the knowledge essential for making the best use of the forests of the whole country.

Forest-research opportunities were expanded during the year in three important ways. Emergency allotments permitted current investigative projects to be pushed forward and the physical equipment of the various research units to be built up. In consequence the research organization was able to give much cooperative assistance to the national-forest administrative organization, the Civilian Conservation Corps, the Federal Housing Administration and other agencies by supplying specific information and technical aid in a wide variety of fields.

A second broadening of opportunity resulted from the establishment of the Rocky Mountain Forest and Range Experiment Station, serving Colorado, Wyoming, and portions of adjoining States. This station completes the chain of continental forest experiment stations authorized in the McSweeney-McNary Forest Research Act. The shelterbelt program, however, makes evidently desirable another station to serve the Great Plains region, where a myriad of problems connected with the planting of shelterbelt stands are beginning to arise.

Finally, research has been greatly facilitated in the East and South by a considerable increase in the area of experimental forest made available to Forest Service research units. These include 1,680 acres of shortleaf pine forest in southern Arkansas, given outright to the United States by the Crossett Lumber Co., specifically for research use; and 1,600 acres of typical northern hardwood forest, adjoining Williams College in Massachusetts, deeded to the Federal Government by the board of trustees as the "Lawrence Hopkins Memorial Experimental Forest." The Maine Legislature this year made possible the purchase of a portion of the Bates College Forest, on which forest-management records have been maintained for the past 12 years. Other new experimental areas include the Palustris Experimental Forest of 4,100 acres, chiefly of longleaf pine land, established on the Kisatchie National Forest in Louisiana, and two additional wilderness areas, totaling 2,500 acres, available for forest research, one in Virginia and the other in Arizona.

The funds made available for research activities during the fiscal year 1935 under various appropriation items and through executive allotments are shown in table 21, in comparison with the amounts appropriated and allotted for 1934 and appropriated for 1936.

TABLE 21.—*Appropriations and allotments of Federal funds for research, 1934-36*

Class of research	1934			1935			1936 ³
	Appropriated ¹	Allotted ²	Total	Appropriated	Allotted ²	Total	Appropriated
Forest management.....	\$386, 095	\$72, 426	\$458, 521	\$392, 810	\$219, 949	\$612, 759	\$504, 49
Range investigations.....	78, 386	47, 367	125, 753	81, 025	126, 811	207, 836	154, 43
Forest products.....	444, 376	-----	444, 376	459, 725	214, 610	674, 335	508, 36
Forest survey.....	125, 205	275, 749	400, 954	118, 543	757, 738	876, 281	250, 00
Forest economics.....	47, 126	15, 566	62, 692	48, 493	40, 768	89, 261	73, 29
Erosion and stream flow.....	65, 341	40, 535	105, 876	67, 642	226, 261	293, 903	99, 15
Forest taxation and insurance.....	35, 759	-----	35, 759	45, 000	-----	45, 000	45, 00

¹ Amounts made available by the Agricultural Appropriation Act less the amount withheld under the provisions of the Economy Act and by the Bureau of the Budget.

² Amounts made available through allotments from emergency appropriations, in part subsequent to the preparation of last year's report.

³ It is not practicable at this time to include the total of emergency allotments which will be available for research during the fiscal year 1936.

⁴ Allocated from National Industrial Recovery Act funds in lieu of regular appropriations.

FOREST ECONOMICS

For a number of years progress in the application of forest management and the adoption of sound industrial and social plans in forest regions has been evidently impeded by the lack of essential forest-economics data. Investigations of the Division of Forest Economics during the year have been primarily designed to obtain and interpret data of the character needed and called for by public administrators, economists, and industrialists.

The wide-spread reversion of cut-over forest land to public ownership through tax delinquency constitutes a serious economic and fiscal problem, particularly in the Lake States, the South, and the Pacific Northwest, where studies of this subject were continued. Accurate knowledge of the character and amount of forest land that is being abandoned and of the reasons for its abandonment is essential for the proper shaping of public policy. Data of this character are being obtained and are being used by such agencies as State forestry commissions, conservation boards, and planning boards; the Land Policy Section and the regional planning boards of the Agricultural Adjustment Administration; various units of the Federal Government concerned with reorganization and improvement of local governmental functions and better land use; chambers of commerce, county courts, and other county officials; and universities.

Facts bearing upon the instability of forest-land ownership in the Douglas-fir region were published in map and mimeograph form. These included data on the character of ownership; the status of tax delinquency; trends in tax base, levies, and collections and in public debt; and the dependence upon forests for tax revenue and employment. Broad use has been and is being made of this information by public officials and by private persons. In addition, the relation between topography, soil, cover, ownership, and tax delinquency in sample areas was investigated. Members of the staff officially and actively participated in regional and State land-planning activities, and acted in an advisory capacity in formulating principles affecting the use of land and in drafting remedial legislation. As a result a number of constructive forest and other land measures were passed by the 1935 legislative assemblies of Oregon and Washington.

Foresters have long believed that conservation of the forests will be promoted by selective or partial cutting instead of indiscriminate clear cutting. Lumbermen have practiced clear cutting because they thought that anything which added to the volume obtained would help to carry overhead costs. Studies of production costs and values for trees of various sizes, which are being conducted in the Pacific Northwest, California, the northern Rocky Mountain region, the Lake States, and the South, are demonstrating the financial disadvantages of cutting the smaller trees.

These studies have demonstrated in California that the lumbermen have been losing money in direct costs on every tree cut below 22 to 30 inches in diameter, depending upon the species. For pine trees 12 inches in diameter this loss may be as much as \$10 per thousand board-feet. A report on selective timber management in the Douglas-fir region was prepared for publication. Further studies are under way. The report shows that selective timber management, either by means of individual tree selection or by group selection brings higher financial returns to the operator and is the best means of maintaining production. As a result of this study the Forest Service is preparing to demonstrate the practicability of these methods on selected areas of the national forests, and some private operators are already applying the methods recommended. A bulletin, Application of Selective Logging to a Ponderosa Pine Operation in Western Montana, was published cooperatively with the Montana State University. The accumulated results of studies in this region are being applied by the largest private owners of timberland in Montana.

In the South, studies in second-growth shortleaf-loblolly pine have shown that selective logging of small volumes per acre is feasible and profitable. Such cutting not only affords an immediate financial return but also assures stand improvement and future cuts of high-quality timber. These results have promoted the adoption of selective methods of cutting by a number of large owners of second-growth pine. Studies to determine profitable utilization of worked-out turpentine timber in the naval stores region were continued. A progress report on pulpwood is being prepared. The demonstration of such facts in widely separated forest regions of the country vitally touches the pocketbook of the industry and is winning attention which considerations of public interest did not get.

A report on the forest-fire-insurance investigations in the Pacific Coast States was prepared for publication. A supplementary investigation to facili-

tate the setting up of forest-fire insurance on a Nation-wide basis was initiated in the Northeast.

Records of 1934 stumpage and log prices in all forest regions were compiled. Preliminary data were furnished to governmental and private agencies at their request.

In the South a report entitled "Tax Delinquency of Forest Land in Arkansas" was extensively revised and brought up to date for publication by the Arkansas Agricultural Experiment Station. In connection with the Forest Survey, a study of land ownership, tax delinquency, valuation and taxation and public finance was completed in 10 counties in southern Georgia and in 12 counties in northern Florida. These data will be correlated with data on the forest resources and on the industrial and social status of these sections to aid in developing sound forest-land-use policies and in increasing the contribution which forests make to the general welfare. In the Lake States economic studies were carried on in connection with the Forest Survey to determine the situation in regard to ownership and tax delinquency of forest lands in northern Minnesota and Michigan.

THE FOREST SURVEY

The demand is constantly increasing for the detailed information that is being gathered by the Forest Survey, not only from regions where the work is under way but also from regions where it has not yet been possible to initiate work. Substantial progress in both field and office work was made, only a small part of which could have been accomplished without the help of emergency funds. Field work was completed on more than 150 million acres, of which over 100 million acres were in the South.

About 15 million acres in the Lake States were covered by inventory crews, and detailed studies of growth, volume, and depletion were made. Field work was completed in Minnesota and a preliminary report released. Office and computational work is proceeding rapidly.

In the South the field inventory was completed for 107 million acres. Office work progressed sufficiently to permit the publication of 14 preliminary releases, principally to satisfy the demand for data on naval stores and pulpwood supplies. A preliminary report dealing with the social and economic phases of the survey as well as the inventory and requirement phases for a unit of 10 million acres in Florida is being prepared for publication. The special studies of social and economic factors needed for comprehensive regional and State reports are well under way.

In the northern Rocky Mountain region, approximately 9 million acres of forest land was mapped. The area covered includes the most broken type conditions as well as some of the most valuable timberland in the region. Cruise data were collected for practically all the merchantable timber owned by the State and large private owners in western Montana. Compilation of type areas has been done on 75 percent of the area covered. Much preliminary work has been done on the growth, drain, and requirements phases of the Forest Survey.

The major contributions of the Forest Survey in Oregon and Washington have been the release of base maps, type maps, and summaries of Survey results. Detailed 1-inch-to-the-mile type maps were prepared for 42 counties, involving a total area of about 45 million acres. Several hundred copies of these maps have been purchased by lumber and pulp companies, timber brokers, and State, Federal, and county officials such as Army engineers, Agricultural Adjustment Administration boards, State foresters, land-planning consultants, county assessors, and State tax commissions. In addition, a very large number of the maps have been used by administrative officers of the Forest Service. State cover-type maps for the western portions of Oregon and Washington were made at $\frac{1}{4}$ -inch-to-the-mile scale and are being lithographed in colors. Over 1,000 copies of Forest Research Notes No. 13, which recapitulates the inventory data for the Douglas fir region, and voluminous compilations of inventory data of a more detailed nature were published and distributed. A large number of requests for special statistical and map data were met. For the Douglas fir region all computations and recapitulations for both the depletion and the growth phases were completed, and the final unit reports covering inventory, growth, and depletion, with analyses of these and related economic data and recommendations, were prepared in tentative form for the 11 national forests in that region. East of the Cascades in Washington and Oregon, type mapping and cruising were completed for 10½

million acres of forest land. It was necessary to cover more than 40 million acres of different types of land in order to get the data for this area.

In California, cover-type maps of over 4 million acres were completed and prepared for publication. These maps have been of wide-spread usefulness to a large variety of agencies, including National and State land agencies and planning commissions, universities, private firms, and individuals.

A survey of lumber and other forest products used in rural construction in sample counties in 26 States was completed, the data tabulated, and analysis begun. The indications are that lumber used on farms during the past 5 years has been about 40 percent of that normally required for repairs and replacements. Studies of lumber requirements for urban construction, particularly housing, were continued.

A study of lumber used in 1933 by secondary wood-using industries, which was begun last year in response to a request from the Lumber Code Authority, was completed and the results published.

FOREST TAXATION

The principal conclusions of the Forest Taxation Inquiry were summarized and published in circular form. A comprehensive report containing these conclusions in full, with the underlying theoretical and factual background, is in course of publication. The taxation staff has cooperated with local agencies in several States in the study of forest-tax problems, and has advised in connection with the drafting of proposed forest-tax laws.

FOREST-MANAGEMENT INVESTIGATIONS

A new milestone in the development of forest-management research has just been reached as the Forest Service acquires by gift the work and physical plant of the Institute of Forest Genetics at Placerville, Calif. This institute, formerly known as the "Eddy Tree Breeding Institute", was founded in 1926 by James G. Eddy, a public-spirited lumberman of Seattle. Financial reverses in late years faced the institute, with the complete loss of the valuable work under way. Grants from the Carnegie Institution of Washington and temporary aid from the Bureau of Plant Industry and the Forest Service tided the institute over its most difficult period, until Congress provided for its continuance. This valuable line of investigation is now to be carried as a part of the activities of the California Forest Experiment Station. The new activity marks the first step in a program of genetical studies long contemplated by the Forest Service. Many genetical problems are pressing for solution. As soon as possible, such investigations of the southern pines, northern conifers, and eastern hardwoods will be begun to supplement the new work on western species.

SILVICULTURAL PRACTICES

The pressure for additional information in silvicultural measures to aid in the Civilian Conservation Corps work placed a heavy burden upon the experiment stations. In every region they have been under great pressure to release the findings of current work and to summarize past results. In some regions the station personnel has been heavily drawn upon by the administrative agencies to aid in training cultural foremen and to give advice on technical problems. A large amount of material covering practically every phase of forestry has been released, and several handbooks have been prepared. One of the earlier Civilian Conservation Corps publications on stand improvement has been revised. Other papers, issued in mimeograph form, cover such fields as direct seeding, soil scarification as a means of increasing desirable reproduction, girdling and poisoning of undesirable species and trees, weeding and clearing young plantations and dense stands of reproduction, thinning sprout stands and dense stands of young growth, releasing desirable reproduction from inferior and weed species, and pruning methods to improve quality growth. The basis is thus being laid for a type of silvicultural practice suited to American economic conditions, species, and forest sites.

Intensive studies of various factors affecting the early growth of longleaf pine seedlings reveal that root competition materially retards the rate of growth in stands of from 25 to 100 thousand seedlings per acre but that densities of from 1 to 25 thousand seedlings per acre allow normally healthy and vigorous growth. Competition from grass is also a factor. Seedlings

on areas from which the grass was removed immediately responded, showing consistently greater growth than where the grass cover had not been disturbed. A heavy growth of vegetation and dead, matted grass litter is a serious deterrent to quick reproduction on cut-over lands in the South. Seeds of slash pine usually manage to reach the mineral soil, but seeds of longleaf tend to hang up in the litter, where they are destroyed by birds, rodents, fungi, and insects, or germinate before reaching the soil. As the longleaf pine produces good seed crops only once in several years, this is a most important factor.

A branch of the Lake States Forest Experiment Station was established in 1931 in McHenry County, N. Dak., to test the feasibility of forest planting on poor, sandy, nonagricultural land, of which there are at least 300,000 acres in the State. On the basis of this work, national-forest purchase units aggregating 260,000 acres have been approved in North Dakota by the National Forest Reservation Commission. Four seasons of planting have afforded a high degree of success, despite the drought and the difficult conditions. Some species have proved unfit, but others have shown marked ability to survive and make growth. Eastern and Rocky Mountain red cedar, ponderosa pine, Scotch pine, and jack pine appear to be the best conifers, and green ash, bur oak, hackberry, American elm, and cottonwood the best hardwoods. Red cedar and green ash seem to be definitely suited for large-scale planting, both species having shown a survival of from 40 to 65 percent at the end of the third growing season. Furrow planting has been demonstrated to be suited to some species but definitely not to others. Cultivation of the planted trees for a period of from 2 to 5 years will probably be necessary.

The technique for testing the drought and heat-resistance of tree seedlings in a "drought machine", developed experimentally last year, was further improved, permitting over 600 tests to be made. One important finding was that seedlings are less resistant to the effects of high temperatures at high than at low humidities. This indicates that transpiration has a cooling effect and thus tends to protect the plant from high temperatures.

The wide-spread use of black locust in erosion-control plantings has created a demand for information as to how to grow this tree in forest nurseries. The locust seeds tend to germinate slowly and often require a period of several years for complete germination. Two ways of hastening the germination period were developed. One, developed at the Southern Forest Experiment Station, treats the seed with sulphuric acid to destroy the impermeable coat. Prompt sowing insures a high percentage of germination within a short time. At the Central States Forest Experiment Station a form of mechanical abrasion was perfected by which, with a relatively simple equipment, the seed coat is broken and so abraded as to permit water to permeate. Germination up to 90 percent has been so obtained. The value of both methods has been demonstrated by sowings on a large scale in State and Federal nurseries.

The Central States Station issued a warning against a practice, commonly advocated, of mixing conifers with black locust in an effort to reduce damage from the locust borer. Investigations show a consistent failure of conifers in such mixtures, due in part to inability to penetrate the leaf canopy of the locust.

SHELTERBELT INVESTIGATIONS

The launching of the shelterbelt project as a part of the drought-relief program necessitated a critical study of the Great Plains region to determine where the shelterbelt zone should be located and the conditions under which it should be established. Accordingly, a region-wide investigation was inaugurated by the Lake States Forest Experiment Station to provide orientation; a critical analysis was made of the climate, soils, geology, native vegetation, and results of past plantings. This was supplemented by a consideration of economic factors, information on tree enemies, and certain documentary material descriptive of the region. Other details collected included the accumulated trial-and-error experience of past windbreak planters and the results of similar work in other lands. The aid of many Federal, State, and private individuals was enlisted. Of special value was the work of the Division of Soil Survey of the Bureau of Chemistry and Soils, the Weather Bureau, and the dry-land stations of the Bureau of Plant Industry.

The evidence thus collected defined the possibilities of shelterbelt planting, outlined the zone in which planting was feasible, provided a broad program for shelterbelt development in the region, and furnished a more or less empirical basis upon which to proceed immediately. Planting began in the spring of 1935. A comprehensive report covering this investigation has been prepared.

FIRE RESEARCH

Fire research continues to demonstrate its value in developing better detection, transportation, and communication systems. In the northern Rocky Mountain region, for example, fire-control measures based on investigative work were actually applied to whole groups of national forests before the research results could be published; and the national forests of this region are now covered by a system of look-outs, smoke chasers, and transportation facilities which furnish better protection at a 20-percent lower cost. Similar studies are being used as a basis for protective planning in other national-forest regions, by the National Park Service, and by some private and State timber-protective organizations. The California Forest Experiment Station practically completed a study of communication systems on the national forests of region 5 which revealed many weaknesses in the location and type of construction of telephone lines and showed that 400 miles of telephone lines should be reconstructed, 1,330 miles abandoned, and 3,243 miles of new line built.

Definite progress was made in the development of methods of measuring fire danger as the initial step in the proper planning of fire control. A visibility meter developed at the Pacific Northwest Forest Experiment Station indicates the distance in miles at which a standard smoke can be detected, thus permitting readjustment of the detection system to meet changing haze conditions. In a similar manner, though on an expanded scale, the fire-danger meter developed at the Northern Rocky Mountain Station furnished a means of interpreting into terms of current fire danger measurements of meteorological and field conditions taken at a large number of forest stations, thus permitting readjustments of the protective force. Since its first appearance, this meter has been materially improved. It is now widely employed in the northern Rocky Mountain region.

Damage studies continue to contribute materially to our knowledge of the role of fire in the forest. Studies by the Appalachian Forest Experiment Station in pitch and shortleaf pine stands showed that during a 10-year period following fire the wounded trees grew in basal area from one-fifth to one-third less than similar trees on adjacent unburned tracts. Hardwoods in the Appalachians are commonly subject to butt rot, of which 94 percent occurs in fire-scarred trees. In the Northeast, from 25 to 45 percent of such trees on the areas studied died during the year following injury. In the naval stores belt defoliation by fire results in marked reductions in gum flow; with complete defoliation the flow from longleaf pine was reduced 50 percent during the first season. Recovery appears to follow closely the recovery of the crown, and defoliated trees should not be turpentine for at least 1 year after the damage. In the longleaf pine type, carefully controlled burning under competent supervision and under proper conditions may aid silviculturally in preparing a seedbed for the natural fall of longleaf seed, in controlling the brown-spot needle disease on some sites, and in reducing competing vegetation and excessive fire hazard. The inherent dangers of indiscriminate burning, however, are enormous, and considerable additional study is necessary before burning can be properly evaluated as a silvicultural tool.

EROSION STREAM-FLOW INVESTIGATIONS

In 1930 Congress provided funds for soil-erosion investigations in the Department of Agriculture. These funds were administratively divided among the bureaus interested in such work—the Bureau of Chemistry and Soils, the Bureau of Agricultural Engineering, and the Forest Service. At the time of the legislation the Forest Service presented a program for erosion stream-flow investigations on forest and range lands. As the work got under way, it became evident that to supply the basic facts necessary in the management of wild lands for watershed purposes required an enlarged program providing more fully for the differences in regional problems due to dissimilar topography, climate, and soil, and especially to differences in the character, distribution, and past treatment of the natural vegetative cover. This enlarged program has accordingly been formulated.

The purpose of the program is to determine the effect of forest, brush, or range cover, or of combinations of them, on erosion and stream flow. It seeks to determine whether such vegetative cover may be used as the major means of obtaining satisfactory conditions of water flow and of controlling erosion on entire watersheds or important parts of watersheds; and, if so, whether it must

be in a virgin condition or may be modified by cutting or grazing. The program will undertake to develop methods for the conservation of soil fertility and moisture for growing forest and forage crops, and for the delivery of the maximum amounts of usable water for irrigation, municipal use, power, navigation, and other purposes; to stabilize dunes; to determine how to make waste lands productive; to protect against destructive floods, and to safeguard public and private works investments which already run into hundreds of millions of dollars. In short, it is designed to furnish for forest and range lands facts and remedial measures as a basis for action by Federal, State, and other agencies.

The work falls into two general classes:

1. *Intensive studies.*—Each of these contemplates a series of intensive measurements upon duplicate forest or range watersheds, the cover on which can be varied so that its effect may be determined. The program provides for 25 of these studies. They will need to be accompanied by other intensive investigations which break the problem down into factors, such as the amount of water used by the natural cover, and measure them separately.

2. *Supplemental studies.*—These comprise investigations on a smaller, less intensive scale, designed primarily to get at the relation of forest or range cover to both water and wind erosion and its control. In part they will be used to check under somewhat different conditions the results obtained in the intensive studies. Twenty-two of these supplemental studies are scheduled.

The program as a whole aims to provide the basic data for forest and range management not only on the national forests and other public areas but also on all privately owned nonagricultural lands. The soundness of this conception of its field has been recognized in the recent reorganization of soil-erosion work in the Department, by the very clear definition of the scope of research to be handled by the agencies most concerned—the Soil Conservation Service and the Forest Service. The research of the Soil Conservation Service is to be directed to lands primarily agricultural in character, while that of the Forest Service is to relate to forest and range lands, including the influence of plant cover on run-off, stream flow, flood control, soil-erosion control, and climate.

The Forest Service program will be carried out as part of the activities of the regional forest experiment stations.

The investigations of the year continued to build up impressive evidence of the effect of vegetative cover in reducing surface run-off and erosion and in regulating stream flow. Progress was materially expedited by the availability of labor for making major installations for watershed studies, and also in part by emergency funds that permitted the temporary employment of competent personnel trained in soils, ecology, and hydraulic engineering.

Study of the geologic record in the Centerville-Farmington section of northern Utah showed that recent floods in this vicinity have cut channels to extraordinary new depths, and have deposited debris and sediment far in excess of the previous normal rate. The origin of these floods can be traced primarily to relatively small areas in the heads of canyons which have been depleted of vegetation and denuded of plant cover by overgrazing and fire. On thickly vegetated parts of the watersheds run-off was not sufficiently concentrated to cause gullying regardless of the steepness of the slopes, though the rainfall was approximately equal. Investigations on widely separated areas in the Colorado River drainage show that on overgrazed areas the plant cover has been reduced by from 33 to 60 percent, and elsewhere has been badly damaged by logging and fire. Studies in the same locality show that the rate of erosion is affected not only by the density of vegetation but also by the vegetative type. In weed vegetation 54 percent of the area of study plots showed serious erosion, as compared with only 12.1 percent of similar plots in aspen, 15.4 percent in browse, and 27.1 percent in sagebrush.

Forest litter alone materially decreases run-off and erosion. In southern Mississippi, the application of forest litter to plots in seriously eroded fields with a 10-percent gradient, decreased the run-off from 1 year's precipitation by more than 50 percent, and the soil loss by nearly 99 percent. The litter also materially increased the ground storage of the rainfall, despite an extremely compact and unabsorptive soil condition; even in heavy rains, ranging from 2.20 to 6.34 inches, the litter-covered soil absorbed from 32 to 88 percent more rainfall than exposed soil. In the Appalachian region, removal by fire of the litter under an old-growth pine-hardwood forest produced 10 times as great an average surface storm flow as that from adjacent unburned plots, and raking the litter off for 4 years produced 160 times as great.

The importance of proper management practices on lands devoted to multiple use was emphasized by a study on the Boise River watershed in central Idaho dealing with the effect of vegetation on the accumulation and rate of melting of snow. On many watersheds of the West a high proportion of usable stream flow originates from winter snowfall. The Boise River water users have feared that any future cutting of timber would detrimentally affect their supply of irrigation water. The study showed that in ponderosa pine with advance reproduction the forest cover does intercept up to 30 percent of the snowfall. In younger stands or in stands with broken canopies the amount is much less; and small openings between trees in the forest were found almost if not quite as effective in accumulating snow as large open areas beyond the influence of the forest. Delayed melting of the snow under the forest cover desirably retards the run-off and better distributes the peak flow. The study indicates that stands managed on short rotation, or under a system which will maintain numerous small openings in the stand rather than a continuous crown cover, will insure an optimum water yield, combined with timber production and soil protection.

Considerable progress was made in revegetation and resultant erosion control on badly gullied and eroded lands. As a result of information derived from research, some 5,500 acres were successfully reseeded on the Angeles National Forest, largely by sowing to mustard, the most effective means of establishing immediate erosion control on large burned areas in southern California. The total sown on this forest has been 32,000 acres, of which 12,500 was sown by airplane and the rest by ground crews. Gully control is being attempted by dense planting with cuttings of native willows in the gullies proper, accompanied by direct sowing of pine and oak seed on the slopes between. Direct seeding has proved effective when the seeds are not destroyed by rodents. Similar work upon the loessal soils of southern Mississippi involved the test of various preparatory operations, a study of planting technic, and a check of the suitability of various species. Some 19 tree and 14 herbaceous species have been tested to date.

One of the most valuable species is black locust. The sulphuric-acid treatment to increase the germination of its seed proved very effective in extensive field tests at Holly Springs, Miss., in 1934, approximately doubling the yield of seedlings. On the station's recommendation, the Mississippi Forest Service treated approximately 6 tons of black locust seed for use in growing seedlings for the extensive Civilian Conservation Corps gully-control work in northern Mississippi.

As a minor phase of erosion control work, both the California and the Appalachian Forest Experiment Stations worked out successful methods of road-bank control as a supplement to good road construction. Exposed banks are an unsightly drawback to roadside appearance, and active erosion on such banks increases the cost of road maintenance and has a detrimental effect on stream flow and upon the feeding conditions for game fish. Practices developed by the stations have now been put into effect on many miles of mountain roads in the national forests, and are being widely accepted by other road-building agencies.

FOREST-PRODUCTS INVESTIGATIONS

Large-scale readjustments of land use, reducing agricultural demand and making a larger area available for forestry, increase the need for a broader market for timber crops. The wages of hundreds of thousands of workers, the life and vigor of a large group of industries, tax revenues, and the support of local communities from one-third of the Nation's land area, will depend more and more upon finding out how to make wood meet modern technical and service requirements at a price which users are able to pay. The fact that the consumption of wood, both per capita and total, has been declining in the United States over a long period of years is a challenge that must be faced and answered. Furthermore, it is urgently important, in the period of temporary scarcity of prime large timber that looms directly ahead between times of depletion and regrowth, that the smaller sizes of trees be made more serviceable through new and improved adaptations to use, so that wood shall not lose ground permanently under the competitive pressure of other materials. All these considerations add deepening significance to the work of wood-utilization research centered at the Forest Products Laboratory.

IMPROVEMENTS IN THE FIELD OF WOOD CONSTRUCTION

An advance made during the year which promises a larger share for forest products in the Nation's home-building program was the development of prefabricated all-wood house-construction system. Research on various house parts has been previously reported. The search for an assembled type of housing is wide-spread but mostly in directions that lead away from the use of wood. The laboratory's system demonstrates that wood can be formed in standard-sized, easily fitted, weather-tight units that can be speedily assembled into a comfortable dwelling. These units are wall, floor, and roof panels built on the stressed-covering principle, which develops high factors of strength and rigidity in proportion to weight. They are fabricated by gluing plywood to suitable framing, and by means of specially designed mullions and interlocking joints they can be built up into houses of a wide variety of sizes and room arrangements. Electric wiring and service outlets are part of the panel construction.

A complete sample house embodying the new system was erected for demonstration purposes and aroused wide interest among architects, engineers, manufacturers, and the general public. Its assembly required only 21 hours of work by a crew of seven men. Further research is directed toward refining certain details of the system in line with manufacturing practice. Under factory methods of producing the component panels, this prefabrication system holds possibilities of low cost and satisfactory quality that may contribute largely toward solving the Nation's housing problem.

In structures of the future, plywood must play an increasing part. In strength and nail-holding ability, the uniformity of its properties, the large lightweight units in which it can be used, and the relatively small waste attendant on its manufacture promise that with further technical improvement and adaptation it will materially broaden the field of wood use. The laboratory purposes to promote this development vigorously. In addition to the plywood panels in the prefabricated house assembly, plywood units were used for the roof and walls of a large storage and utility building erected on the laboratory grounds. Its service will afford a test of the practicality, economy, and long-time weather resistance of this new form of industrial construction.

Accelerated exposure tests were begun to determine the durability of the newer types of plywood glued in the hot press with synthetic resins. Mechanical tests of plywood of different thicknesses and numbers of plies are in progress having as their objective the calculation of the strength of the material with reference to various engineering and industrial uses. In preparation for a fundamental study of plywood, from log to finished material, an experimental veneer-cutting plant was installed. Objects in view include not only the production of plies of a wide range of thicknesses for fabrication and testing and the determination of the most favorable methods for cutting veneers from woods of different species, but also experiments looking toward the production of useful veneers from logs of smaller size and lower grade than are now thus utilized.

The strict requirements of modern engineering have unfavorably affected the wood market by displacing vast quantities of timber in favor of other materials in heavy construction. This tendency can be countered only by a strong and continued technical advance in timber design and fabrication, certain lines of which are already well marked out.

Glued and built-up construction offers an opportunity to utilize small sizes of lumber in the fabrication of large, strong members specially shaped and adapted for the structural use required. The advantages of laminated wood arch construction were given practical demonstration by the use of solid arch box-type glued arches of 46-foot span as framework for the utility building referred to above. The cubic-foot cost of the building as a whole was low, erection was simple and rapid, and a large gain in interior working space was secured by virtue of the arched framing. Tests of full-scale duplicate arches closely checked the high strength values that had been calculated.

General data on plate-and-ring connectors for improved modern types of timber framing were supplemented by detailed tests to determine the most efficient conditions of their use. Definite information was obtained as to the proper spacing of connectors, the numbers and sizes required for given loadings, the placement of bearing rings, and other factors.

The preparation of the wood handbook was completed and the manuscript sent to press. This work, bringing together basic information on wood as a

material of construction, along with data for its use in design and for the preparation of specifications, marks an important step toward placing wood on an equivalent technical basis with other structural materials. Moreover, it will contribute directly to efficient use of wood in the Nation-wide building activity that is now under way or in prospect.

Research on coatings and treatments to improve the service of wood in construction and to reduce maintenance charges brought several new developments. The addition of flake graphite to priming paints proved effective in retarding the disintegration of paint coatings over the hard bands of Douglas fir and Southern yellow pine, thus providing a long-sought means of lengthening the service life of paints on such woods. Among the many types of good paints now on the market certain incompatible combinations were discovered when different types are used at successive repaintings. The form of failure resulting from incompatibility closely resembles the early scaling of paint on houses with damp side walls. By selecting the proper repainting materials many expensive failures hitherto unexplained can be avoided. These findings open the way to further study of modern paints during long-time maintenance. Marked fire-retarding effects were obtained by coating wood with several types of chemicals of known fire-retarding properties mixed with sodium silicate, blood albumin, artificial resins, and other binders. Such surface coatings may provide effective protection to wood in many types of construction, at a lower cost than with impregnation methods. A laboratory process for minimizing the shrinking and swelling of wood by replacing the water with nonvolatile materials such as resins and waxes was developed. The process may prove commercially practicable as a combined seasoning and antishrink impregnation treatment in certain exacting uses, such as flooring. New records were begun to determine the average service life of installations of wood treated with proprietary preservatives, by means of which it is hoped to obtain factual valuations in a confused field of claims and counterclaims. A manual covering the theory and practice of preservative treatments of wood by pressure processes was published as a technical bulletin.

TIMBER-STAND IMPROVEMENT, HARVESTING, AND UTILIZATION

In plantations of northern white pine and Norway pine, dead branches were found to persist for so long a time that little or no clear lumber could be expected in rotations of less than 80 years. Loblolly and shortleaf pine were found to clear their branches more readily, especially in stands containing broad-leaved species, where the formation of clear wood begins in from 20 to 25 years. In any case, artificial pruning would afford great advantages wherever it can be made practicable. A portable power-driven pruning saw was developed, with the motor unit carried on a light drag and the circular saw mounted on a hollow extensible aluminum pole, which practically doubled the acreage that could be pruned in a day by one man—a gain of considerable importance in stands under intensive management.

The profitable use of thinnings and small trees from improvement cuttings was aided by several developments, including the construction and demonstration of simple machinery for shaping resin cups from waste-pine material, and the design of a special type of log house for subsistence-homestead projects, in which the walls are formed of small split logs set vertically.

The large amount of sample material collected in field investigations of southern lowland hardwoods was intensively studied. Without better knowledge of these woods there is danger of a further abandonment of many acres of forest land and the unemployment of additional thousands of men. Machining qualities, including turning, planing, and shaping characteristics, concerning which practically no systematic information was available, were established by carefully-controlled tests of 18 species. Some of the less used "weed" species were found to rate high, especially in turning qualities. Bottom-land white ash was found to be very inferior in quality to upland white ash, but by segregating according to structural characteristics and growth conditions much of it was proved suitable for specialized uses. Material progress was made in the development of apparatus for measuring and recording the smoothness of the dressed surface with mechanical accuracy. Such measurements in place of dependence upon a system of visual inspection will set a new standard of wood evaluation, needed by all the woodworking industries.

Hardwood species from lower elevations and the Mississippi Delta were compared as to shrinkage properties with species from the mountain sections of Tennessee and Kentucky. The data afford a new and reliable basis for estimating the quality of second-growth timber from highland and lowland areas throughout the South. Regularity of the shrinkage variation with position in the tree made possible the construction of a shrinkage diagram for white oak, showing volumetric shrinkage zones of less than 15 percent in the sapwood, but of more than 24 percent toward the center of the tree.

Logging and milling studies on which to base selective logging and other forest practices were made in hardwood stands in Virginia and West Virginia and in softwood stands in New England. The latter studies indicated that white pine trees of smaller diameter can be logged more profitably in New England than in any other region thus far covered or than trees of any other species. Four studies were made in pulpwood stands. Data obtained in these studies on costs of felling, crosscutting, trimming, transport, and peeling, together with data on knots, rate of growth, and percentage of summer wood, have direct bearing on the formulation of pulpwood grades as well as upon the determination of minimum cutting diameters.

A naval stores handbook, covering all woods operations in the production of pine gum or oleoresin, was published and is contributing to better turpentine practice on the longleaf and slash pinelands of the South. It was produced through cooperation of the Forest Service, the Bureau of Plant Industry, and the Bureau of Entomology and Plant Quarantine.

CHEMICAL SEASONING

Salt-seasoning methods were successfully extended to additional species and to timbers of large size. Boxed-heart 12- by 12-inch timbers of Douglas fir were kiln-dried after salt treatment to an average moisture content of 11 percent without checking. Dry check-free timbers of this size, rarely available hitherto, can logically be expected to take higher working stresses than would normally be allowed. The checking of western red cedar poles and piling has long been a serious merchandising handicap. Investigations disclosed that this class of material can be salt-seasoned to moisture-content values as low as 12 percent without checking. Noteworthy results were obtained in salt-seasoning green aspen logs, the material after salt treatment being kiln-dried from a moisture content of 110 percent of the dry weight to 22 percent in only 2 days and without degrade.

PULP AND PAPER

Improving and increasing the use of American woods for pulp and paper production is a major objective of forest-products research. Despite excellent progress in substituting other species, spruce is still the most extensively used pulpwood, and this is at least partly the reason why more than half the paper needs of the United States are met by importations of either pulpwood pulp, or paper. Recently interest has centered in southern species, particularly the southern yellow pines, which are available in great quantity. Large amounts of southern pine are now being converted into kraft pulps and paper and a sizable tonnage of bleached pine sulphate pulp has come into the market. A strong movement is also under way to develop commercial newsprint paper from the same species. The area of growth, however, is so wide and the conditions of growth so varied that broad differences which materially affect pulping properties are constantly encountered, even within the same species. Significant progress was made in evaluating these growth differences in terms of pulping quality and in developing a method of classification of wood based upon readily noticeable growth characteristics, such as rate of growth, heartwood content, and proportion of spring and summer wood. Experimental pulping tests revealed that such differences as color, strength, and fiber texture can be compensated by proper selection of pulping conditions and that what heretofore has been classed as a low-quality pulpwood can be converted into chemical pulp of relatively good quality.

In developing further the possible production of newsprint papers from southern pines a careful study was made of the grinding of young loblolly pine. Grinding variables were discovered to be of greater significance than

many of the wood properties, but green wood and wood of rapid growth containing large quantities of spring wood gave the best results.

Western species are also exceedingly important in the potential development of domestic pulpwood resources. In a systematic survey of the paper-making qualities of western species, lowland white fir pulpwood was found to compare favorably with both white spruce and western hemlock in yields and physical properties. Sulphite pulps from lowland white fir contain a relatively high percentage of alpha cellulose and suggest the possibility of their use for rayon pulps, which now comprise 40 percent of the sulphite production on the Pacific coast.

Further progress was made in the substitution of soda for lime in the sulphite process, the waste liquors from which may be readily concentrated and the chemicals recovered. At the optimum concentration of combined sulphur dioxide (2 percent), the strength properties of soda-base pulps showed an increase of 15 percent over pulps prepared with lime-base liquor.

Concurrently with pulping experiments, investigations were made of methods of bleaching, beating, and making paper from pulps from various species. Accurate control of the beating process for the production of desired qualities in a pulp was brought nearer by a new method of measuring the absorption of moisture by pulps, through an application of the standard "freeness" test. Encouraging results were attained in the use, on a laboratory scale, of bleaching solution as a pulping agent. By this method pulps amounting to from 52 to 56 percent of the weight of the wood were obtained from white spruce, the product being apparently well suited to the production of a strong glassine sheet with very little beating. A new unit for the experimental papermaking machine was designed and built, in which the sheet formation, press and calendar pressures, dryer temperatures, and section speeds can be closely controlled. This new equipment will be the basis of investigations of paper-machine effects on the quality of paper from pulps of all types.

OTHER CHEMICAL PRODUCTS

A distinct advance was made in processing wood waste for direct conversion into a plastic material suitable for molding into wall panels, floor tile, table tops, and smaller articles. By the new process a dense, black, impervious plastic was obtained from partially chlorinated sawdust without the necessity of steaming or digestion under pressure, and with a minimum of added materials. The sheet can be molded with a high gloss.

Investigations of lignin continued, with a view to possible adaptations of this second-largest constituent of wood to practical use. The same marked differences between hardwood and softwood lignins were disclosed in 5 species of hardwoods and 3 species of softwoods. A similarity was found among all the hardwood lignins and another among all the softwood lignins. Physicochemical methods showed the lowest molecular weight of the soluble portion of lignin to be twice the predicted chemical value. A complete chemical study of the fats, resins, and waxes, from the phloem and young growing tips of slash pine led to the isolation of numerous new bodies, and a much deeper insight into the complex biochemistry of growth compounds was obtained. Tannins and oleosins were found to be derived from the same precursors and are thus related, but are not mutually transformable.

RELATED INVESTIGATIONS

Besides the leading projects already summarized, several lesser ones deserve brief mention.

Some of the lumber in the ladder used in the Lindbergh kidnaping was conclusively traced to its source by a member of the laboratory, at the request of the New Jersey State police, after a protracted technical study. A new type of instrument for determining the factors influencing forest-fire ignition and spread was developed, and eight instruments were placed in service. The instrument records duff moisture, branch-wood dryness, and wind velocity. An extensive study of the effectiveness of wood as a heat insulator was begun. The results thus far obtained indicate that a difference of even 3 or 4 percent in dryness of wood may make a difference of from 5 to 10 percent in heat conductivity. A machine was installed for the production of container board

in a wide variety of commercial and experimental types and an attack begun on problems of the fiber shipping container that have remained unanswered for 30 years.

In addition to the publications already mentioned, a technical bulletin containing revised tables of the mechanical properties of American woods was issued. A farmers' bulletin on the selection of lumber for farm and home building, a leaflet on the odor and taste-imparting qualities of wooden butter containers, and two technical bulletins, one on the properties and structure of compression wood and the other on the colloid chemistry of cellulose materials, were completed.

RANGE INVESTIGATIONS

The practicability of restoring range vegetative cover on abandoned dry farms in eastern Montana was indicated by preliminary artificial reseeding tests at the Northern Rocky Mountain Forest and Range Experiment Station. Even with seedings made during the dry fall of 1933 and the succeeding droughty spring, 32 percent were considered successful in the fall of 1934 after the most severe drought for 50 years. Some deeply drilled seed that failed to germinate in 1934 finally came up in 1935, and increased the area classed as successful to 40 percent. A much higher degree of success was recorded for the seedings in the fall of 1934 and the spring of 1935. Crested wheatgrass proved the most promising species tested; but slender wheatgrass, smooth brome grass, meadow fescue, Canada bluegrass, tall oatgrass, and Harbottlepedeza also showed economic possibilities. Reseeding may be done ordinarily at a cash outlay of about \$1 per acre for seed, although crested wheatgrass was in such wide demand in 1934 that the cost of seed increased unduly. The additional labor cost for planting is small, as it was found feasible to drill the seed without plowing or other costly preparation of the soil.

Preliminary range artificial reseeding results in the Intermountain Region in past years have been so promising that funds for an intensive attack were provided by Congress in the fiscal year 1936. The problem of restoring grass and other range vegetation is very important to the welfare of the West, and little has been done as yet toward its solution.

That overgrazing significantly increases the cost of producing range cattle in the Northern Plains was demonstrated by a grazing experiment conducted by the Northern Rocky Mountain Station in cooperation with the Bureau of Animal Industry. Shortgrass range near Miles City, Mont., produced so little forage during the severe 1934 drought that hay was required as a supplement during the summer in all of the experimental pastures. On pasture overgrazed in the average year about 25 percent, each cow required 2,027 pounds of hay; on properly grazed range 1,267 pounds, and on normally undergrazed range 848 pounds. Calves from cows on the more conservatively grazed range averaged 72 pounds heavier at weaning than those from cows on overgrazed range. The cost of range and supplemental feed per pound of calf produced in 1934 was about 8½ cents for the overgrazed lot, as against about 3½ cents for the more conservatively grazed lot.

Preliminary studies by the Intermountain Forest and Range Experiment Station showed that the forage production of sagebrush-wheatgrass range in southern Idaho may be increased by light burning when the soil and vegetation are not too dry. Analysis of vegetative data indicates that burns of light intensity will completely kill sagebrush, without eliminating more desirable shrubs. On moderately burned areas the stand of grasses increased 24 percent the first year after burning, with both wheatgrass and junegrass gaining greatly. Analyses of soil samples show that although the effects of burns of light and medium intensities were relatively insignificant, heavy burning caused a very significant decrease in organic matter in the topsoil, accompanied by a decline in nitrogen and in moisture equivalent.

Studies of precipitation and plant growth on summer ranges in central Utah for the past 10 years indicate the importance not only of the total annual precipitation but also of the spring and early summer precipitation, in range-forage production. The amount of moisture in the soil at the time of snow disappearance, plus the precipitation that follows, up to the date grass heads appear, gives a significant index of the ultimate forage yield for the year. Extremely

uneven seasonal distribution of precipitation may cause irregular relationships, as in 1928, when forage yield was high in spite of low precipitation, and in 1930, when the reverse was true.

Both the administrative and the research organizations of the Forest Service have long recognized the urgent need for a compact, readily consultable handbook containing information regarding key plants, of vital bearing on range management, on western national-forest ranges. During the past two winters such a publication has been prepared by a group of administrative and research range experts. Features enabling ready plant identification, expressed in simple diagrammatic or pictorial form, characteristics relating to the importance of the various species, as forage for livestock and game and for erosion control, and data on reproduction, growth, and other characteristics which influence their use are included for over 300 of the more important range plants.

Literature on botanical, ecological, range management, and animal-husbandry subjects pertaining to western range problems has become so voluminous as to bewilder the research worker, the range administrator, and the stockman. Emergency funds available in Washington made possible the employment of the necessary technical and clerical help to complete a bibliography of range management in the West, listing over 9,000 American publications.

EXPENDITURES AND RECEIPTS

The expenditures during the fiscal year were as follows:

General administration.....		\$701, 159. 25
Administration, protection, improvement, reforestation, and extension of national forests:		
Operating expenditures:		
Timber use.....	\$646, 118. 77	
Grazing use.....	774, 948. 27	
Recreation and land use.....	432, 361. 21	
Fish and game protection.....	292, 260. 80	
Classification, settlement, and claims.....	154, 476. 26	
Maintenance of truck and horse trails.....	2, 241, 007. 13	
Maintenance of other improvements.....	806, 698. 53	
Subtotal.....		\$5, 347, 870. 97
Protection expenditures:		
Fire prevention and detection.....	2, 412, 198. 15	
Fire suppression.....	2, 349, 073. 49	
Class total (fire).....	4, 761, 271. 64	
Protection against insects and tree diseases.....	183, 579. 37	
Subtotal.....		4, 944, 851. 01
Investment expenditures:		
Construction of truck and horse trails.....	18, 061, 645. 37	
Construction of other improvements.....	6, 771, 220. 86	
Equipment and stores.....	12, 035, 290. 58	
Timber surveys and plans.....	591, 922. 33	
Grazing surveys and plans.....	174, 642. 99	
Fish and game surveys and plans.....	95, 890. 64	
Recreational-use surveys and plans.....	162, 790. 21	
General surveys and maps.....	437, 687. 88	
Timber-stand improvement.....	1, 311, 801. 27	
Reforestation of denuded areas.....	601, 097. 51	
Nurseries and planting stock.....	246, 075. 53	
Acquisition of land by direct purchase.....	8, 979, 357. 65	
Acquisition of land by exchange.....	1 67, 964. 96	
Nonstructural improvements (erosion, tree-disease and insect control, fire-hazard reduction, and miscellaneous investments not otherwise classified).....	3, 164, 136. 89	
Subtotal.....		52, 701, 524. 67
Construction and maintenance of forest highways:		
Construction of forest highways.....	12, 162, 732. 37	
Maintenance of forest highways.....	777, 015. 81	
Subtotal.....		12, 939, 748. 18
Total, national forests.....		75, 933, 994. 83

¹ In addition to the expenditure for acquisition of land by exchange, national-forest timber having an estimated value of \$219,430 was cut under agreements involving the acquisition of land and timber through exchange. The cash expenditures recorded opposite "Acquisition of land by exchange" cover merely the outlay incidental to examining lands offered for exchange and appraising the value involved.

Plains Shelterbelt Project (including nurseries):

Current expenditures:

General administration	\$77,127.62
Maintenance of other improvements	15,922.16
Protection against insects and tree diseases	46.30

Subtotal.....\$93,096.08

Investment expenditures:

Construction of other improvements	142,922.84
Equipment and stores	118,003.74
General surveys and plans	379.65
Reforestation of denuded areas	97,421.40
Nurseries and planting stock	172,979.71
Acquisition of land by direct purchase	69,099.94
Nonstructural improvements (erosion, tree-disease and insect control, fire-hazard reduction, and miscellaneous investments not otherwise classified)	2,991.43

Subtotal.....603,798.71

Total, Plains Shelterbelt Project.....\$696,894.79

Research:

Research current expenditures:

Forest management	625,409.68
Range investigations	285,467.89
Forest products	889,338.10
Forest survey	544,255.68
Forest economics	59,971.59
Erosion and stream flow	333,508.75
Forest taxation and insurance	19,156.30
Maintenance of roads and trails	6,765.73
Maintenance of other improvements	22,068.56
Fire prevention and detection on experimental areas	2,318.53
Insect control and other timber protection on experimental areas	8.36

Subtotal.....²2,788,269.17

Research investments:

Construction of roads and trails	21,553.02
Construction of other improvements	484,514.41
Equipment and stores	359,656.23
Timber surveys and plans; experimental areas	2,708.89
General surveys and maps; experimental areas	89,421.52
Timber-stand improvement; experimental areas	1,221.11
Reforestation of denuded areas; experimental areas	76.06
Grazing surveys and plans; experimental areas	1,881.39
Recreational surveys and plans; experimental areas	166.77
Nonstructural improvements; on experimental areas: (Erosion, tree-disease and insect control, fire-hazard reduction, and miscellaneous investments not otherwise classified)	110,153.47

Subtotal.....1,071,352.87

Total.....3,859,622.04

Protection and reforestation of other than national-forest lands:

Tree planting in cooperation with States	157,957.37
Fire protection in cooperation with States	1,766,130.63
Protection of Oregon and California grant lands	85,296.91
Extension of forestry practice on State and private lands	2,196,445.44

Total.....4,205,830.35

Emergency conservation work on other than national-forest lands:

State and private camp expenditures (1935)	21,449,657.10
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Total.....³21,449,657.10

Miscellaneous:

Emergency unemployment relief; general planning and direction of emergency conservation work	824,722.88
Emergency unemployment relief; Civil Works Administration, Federal Civil Works Administration, etc.	171,655.58
Tennessee Valley Authority; emergency conservation work	922,194.03
Insular forests, Puerto Rico; emergency conservation work	190,475.95
Examination and administration of power sites for Federal Power Commission	9,911.62
Miscellaneous cooperation with other departments, bureaus, and individuals	556,932.70

Total.....2,675,892.76

Grand total.....109,523,051.11

² Includes \$62,801.70 expended from Plains Shelterbelt Project funds.

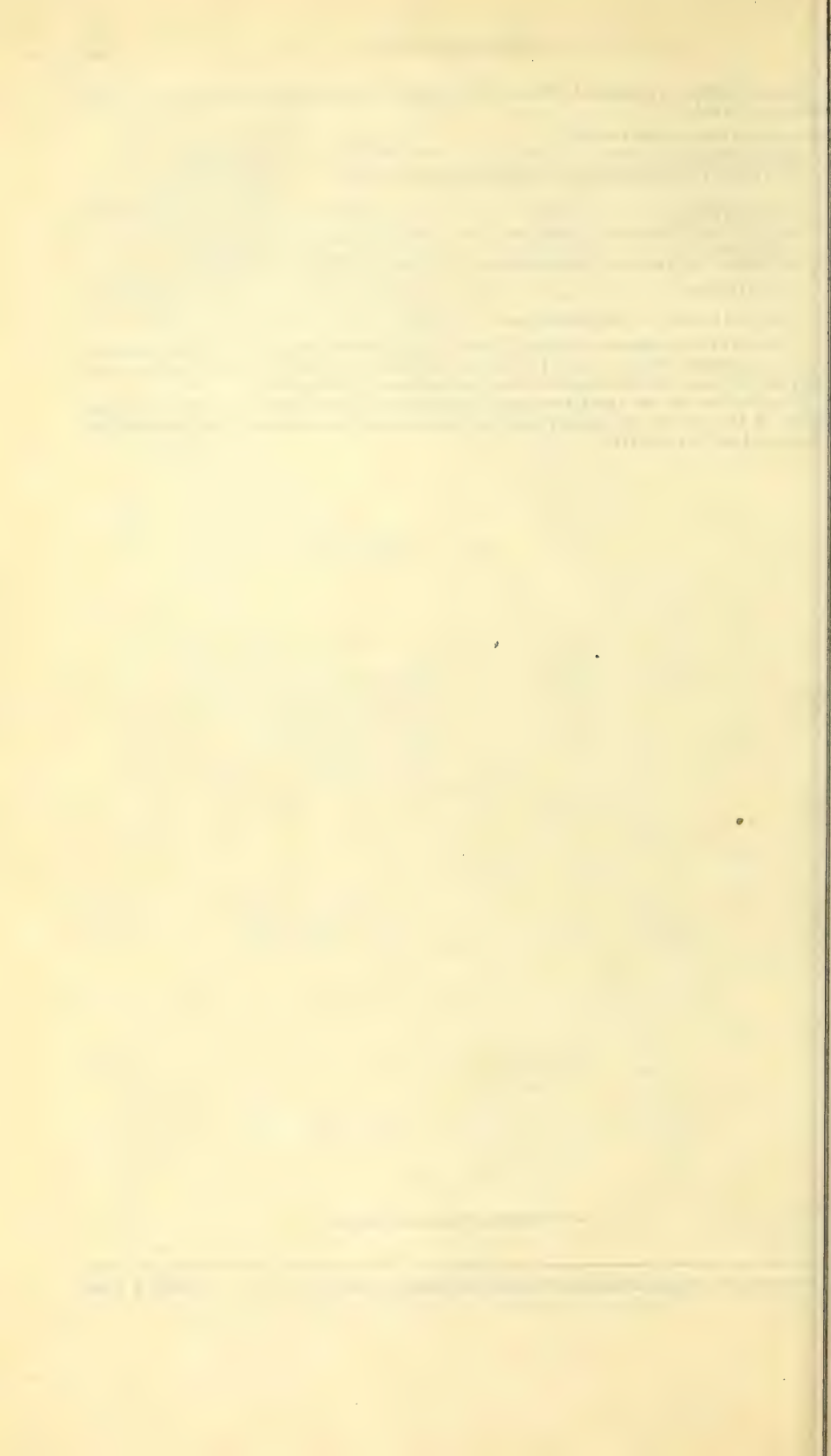
³ Expenditures for comparable work during fiscal year 1933, \$25,374.54, and during fiscal year 1934, \$21,590,564.44, not included in reports for those years.

The following statement shows the gross and net cash receipts from the national forests:

Gross receipts from national forests:	
From the use of timber.....	\$1,731,355.05
From the use of forage.....	1,151,152.93
From special land uses, water power, and miscellaneous receipts.....	408,803.86
Total receipts.....	\$3,291,311.84
Less payments to States:	
To Arizona and New Mexico, account school lands administered by Forest Service.....	20,773.48
To States in which national forests are located (act of May 23, 1908).....	817,634.59
Total to States.....	838,408.07
Net total receipts to United States Treasury.....	2,452,903.77

The total of the gross receipts is less by \$23,379.50 than that for the previous year. Receipts from timber increased \$208,998.86, grazing receipts decreased \$207,535.08, and miscellaneous receipts decreased \$24,843.28.

In addition to the cash receipts from timber, there should be credited the value of the timber cut under specific agreements for effecting land exchanges, estimated at \$219,430.00.



REPORT OF THE CHIEF OF THE FOREST SERVICE, 1936

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., September 1, 1936.

HON. HENRY A. WALLACE,
Secretary of Agriculture.

DEAR MR. SECRETARY: I transmit herewith the report of the Forest Service for the fiscal year ended June 30, 1936.

F. A. SILCOX, *Chief.*

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LAND-USE PLANNING IN THE FOREST SERVICE

A prodigal and wasteful use of soils and their products has characterized the Nation's history. Whether or not there was justification for any part of it during pioneer developments, it now definitely menaces national permanency and progress. Common sense calls for a systematic study of our lands, determination of the types of service for which they are most useful, and the formulation of practicable measures for obtaining these services, both now and continuingly. That defines the essence and purpose of land-use planning. Economic and social service is both its measuring stick and its ultimate goal, impossible of attainment unless the course is determined by combined economic and social planning.

For this planning it is not enough to determine merely the kind of use for which the land is inherently best suited. An appropriate balance must be sought between farm, pasture, forest, range, recreational, wildlife, watershed, and other uses in the light of soundly coordinated national requirements for products and services.

The Forest Service has a definite place in land-use planning. Its participation is called for in helping to determine the lands which ought to be permanently devoted to forest purposes, and in helping to formulate measures suitably designed to promote or assure the use of these lands for the right forest purposes. These purposes include timber production, watershed protection, forage production and livestock grazing, wildlife production, recreational use, and whatever combination of these uses will yield the largest net total of public benefits. Beyond this comes the question of the particular agency through whose ownership and management the best use should in each case be obtained. These agencies are Federal, State, county, and other public and quasi-public, and private, of various forms. And in addition to the question of the class of ownership which should afford the most desirable results, there is the question of the rate at which the requisite major shifts in ownership ought to take place, and how to bring them about.

These questions are extremely complex. The passing of the frontier, the replacement of labor by machinery, and many like changes affecting the economic and social life of the Nation have set up stresses which it is the function of

land-use planning to reckon with and seek to lessen or remove. It must also reckon with the fact that instead of an insatiable demand for agricultural land, the broad trend is toward abandonment, creating large problem areas. The export market for agricultural products is smaller. Submarginality for many uses and for private ownership is now widely recognized. On the other hand, current demand for forest products has fallen off materially. Growing recognition that flood-prevention efforts must be extended to the sources of floods further complicates the process of determining sound principles and procedures of land use.

Other complicating factors include the interlocking of forest and range use, and of both with crop-land use, which has created a whole series of difficult problems; the fact that the requirements of sound forest management have become much more intensive, and thus are often beyond the practical limitations of individual initiative; and expanding public requirements and demands for areas devoted to recreational use, wildlife conservation, and other specialized and restricted services.

In their sum total these factors point to extensive changes in land use. That they should not be left to work themselves out through the slow, painful, and wasteful process of unguided and delayed adjustment to altered conditions is widely recognized. The multiplying planning activities of Federal, State, and other agencies are an evidence. Some of these programs concern practically the entire United States, others entire regions, still others States and lesser political divisions. The public agencies working in this field include the National Resources Committee, the Soil Conservation Service, the Agricultural Adjustment Administration, the Bureau of Agricultural Economics, the Resettlement Administration, State planning boards, State agricultural colleges, and various land-managing agencies of the Federal Government. Other agencies giving attention to land and resource planning include the United States Chamber of Commerce as well as many more local business bodies. The Forest Service seeks and needs to coordinate and articulate the land planning which its own field of activities calls for with the plans of others.

Effective accomplishment requires full data and careful analysis as well as correlation with the work done elsewhere. An adequate system of national forests, for example, must be developed on the basis of a sound appraisal of public requirements as well as in proper adjustment with the plans and programs of other Federal agencies, the States, counties, and towns, and of private forest-land owners. To meet the increasing demands upon the Forest Service for work in this field, it became necessary to work out during the year more definite provisions to coordinate and systematize the land-planning efforts, in which the Forest Service has been engaged from its inception. Both in creating and in administering the national forests—which comprise 9 percent of the land area of the continental United States and bring into the reckoning the widest variety of physical, economic, and social conditions—land-use planning is basic.

For the national forests are put, and must be put, to a multiplicity of uses. Often these uses conflict. Sometimes the conflict can be harmonized, sometimes one use must give way. Making the forests of greatest possible public service would be wholly impossible without careful planning to govern land use. Economic as well as physical factors are of primary importance. Uncorrelated growth of the local and commercial structure supported by forest use has set up many conflicts of interest in the resources, and many attendant strains, demanding equitable adjustment. Yet that eleventh part of the United States which comprises the national forests now presents an advanced example of systematically planned and balanced use, worked out on the basis of promoting the permanent public welfare.

As long ago as 1909 the Forest Service issued a publication entitled "The Future Use of Land in the United States." Subsequent contributions in the field of forest and land economy include a report on forest resources in 1920, A National Plan for American Forestry in 1933, the forestry section of the report of the National Resources Committee in 1934, The Western Range in 1936, two reports on the pulpwood resources of the United States, and the report to the Garfield Committee on the Public Lands in 1930. These reports embody the basic essentials of a national program of land use in its application to a large part of the United States.

One outstanding conclusion expressed in A National Plan for American Forestry was that, with private initiative very definitely in the picture, eventually 90,000,000 acres of the forest lands then in private ownership would

ave to be taken over by the States, and 134,000,000 acres by the Federal Government. The report of the National Resources Committee of 1935, developed in wide cooperation with State and other agencies, forecast an eventual need for State ownership of 60,000,000 acres and for Federal ownership of 118,000,000 acres of the forest lands now privately owned. These were approximations not based on complete data, but they indicate the magnitude of the field in which land planning with a view to forestry must work.

Forest Service land-planning activities have three major purposes. The first is to foster and promote the permanent sustained-yield management of forest lands by private agencies to the fullest practicable degree and by all appropriate means, including correlated public ownership and management of those parts of natural units of forest management not adapted to private ownership. The second is to cooperate with the several States, under the provisions of the Fulmer Act of August 29, 1935, and otherwise, in the development of adequate systems of State-owned and State-managed forests, to the fullest degree dictated by the State interests, means, and limitations. The third is eventually to establish a national-forest status for the forest lands of such character or service as to require Federal rather than private or State ownership and management. Accurate and dependable determination of the forest areas falling in these three categories is prerequisite to effective action. Full attainment of the social objectives of planned land use requires forest community planning. In the future economy of the Nation some millions of its citizens may properly look to the forests for their means of livelihood. Their needs for essential services, social opportunity, and cultural advancement will largely be met through permanent forest communities, based on related forest resources. Continued existence of many communities, originally established by chance, is now threatened by exhaustion of nearby forests. In other forest areas residents are widely scattered and institutional services are inadequate or entirely lacking because of prohibitive costs. Need exists to discover where the available or prospective forest resources and services make feasible the development of community centers where forest workers can live and labor in ways socially and economically desirable.

The cooperation of the Resettlement Administration enabled the Forest Service to make definite progress in this work during the year, some twenty or more forest-management units being studied in detail. In consequence, certain actionable forest-community projects were presented to that administration. The Drummond project in Wisconsin and the Sublimity project in Kentucky have been approved and are now under way, with funds for their construction made available by the Resettlement Administration.

The Forest Service enters the fiscal year 1937 with land-use planning as one of its definite administrative objectives. In attainment of that objective all of the personnel and resources of the Forest Service will be employed as fully as is consistent with other requirements and with the limitations of law and funds.

NEW LEGISLATION AFFECTING THE FOREST SERVICE

The following legislation affecting the Forest Service was enacted at the second session of the Seventy-fourth Congress.

Appropriation acts were:

The Agricultural Appropriation Act, fiscal year 1937 (49 Stat., 1421), approved June 4, 1936.

The Emergency Relief Appropriation Act, fiscal year 1936 (49 Stat., 1597), approved June 22, 1936. Out of this appropriation of \$1,425,000,000 there was made available prior to the date of this report \$5,073,000 for various specified projects, chiefly on the national forests, and for the overhead administrative costs involved.

Other acts relating to national-forest administration were:

The act of June 16, 1936 (49 Stat., 1519), amending the Federal Highway Act. This act contains certain provisions respecting forest highways.

The act of June 22, 1936 (49 Stat., 1570), authorizing public works for flood control, and particularly authorizing investigations by the Secretary of Agriculture with respect to watersheds and measures for run-off and water-flow retardation.

The act of April 17, 1936 (Private, 469) authorizing the Secretary of Agriculture to disclaim the interests of the United States in a certain tract of land within the Ouachita National Forest, Ark., the title to which had been inadvertently conveyed to the United States.

The act of June 4, 1936 (49 Stat., 1460), which added certain lands to the Rogue River National Forest, Oreg.

The act of June 19, 1936 (49 Stat., 1534), extending the Forest Exchange Act to certain lands adjacent to the Umatilla and Whitman National Forests, Oreg.

The act of April 20, 1936 (49 Stat., 1234), restricting mineral locations and entries within a portion of the Santa Barbara National Forest, Calif.

The act of June 15, 1936 (49 Stat., 1515), authorizing a Great Plains forest experiment station.

The act of June 30, 1936 (49 Stat., 2041), providing for the Blue Ridge Parkway in Virginia and North Carolina.

Senate Resolution 217, creating a committee of five Senators to make a study of all the activities of the Federal executive agencies with a view to legislation to bring about simplification, efficiency, and economy.

ORGANIZATION CHANGES

Expanded responsibilities and activities of the Forest Service led to changes in the administrative set-up. The basic type of organization, however, remains the same. It is still both in spirit and in practice a functionalized, decentralized, territorial organization.

The main change was in the Washington office. The need had long existed for greater assistance to the Chief in the task of general supervision and direction of the diversified activities of the Forest Service. Under the pressure of inadequate funds all along the line, the Washington office overhead had through a period of years been cut beyond the quick in order to turn more money into the field. The result was that the Chief as well as the Assistant Chiefs were overburdened with details and unable to give sufficient attention to the large problems of administration calling for thoughtful planning, or to the most efficient coordination and supervision of the whole body of work. Far too many men, all hard put to it to dispose of the business steadily flooding their desks, were reporting to a Chief unaided by an adequate staff. In addition, the rise of new activities and the growth in relative importance of some of the old lines of work had created incongruities and anomalies.

To help meet this situation, a stronger staff organization was required. During the year eight Assistant Chiefs of the Forest Service were appointed. They serve collectively as a staff, with such line duties as are delegated to them by the Chief and performed on his behalf. The number of divisions was increased from 8 to 23. All but one of them are correlated in six groups. Functionalization of the staff work is effected through delegation of authority to certain of the staff officers to act for the Chief on matters coming up from the divisions. The Division of Fiscal Control is an independent division outside this grouping.

One group is concerned solely with National-Forest Administration. It comprises the six Divisions of Timber Management, Range Management, Recreation and Lands, Wildlife Management, Engineering, and Fire Control and Improvements.

A research group comprises the five Divisions of Forest Influences, Forest Economics, Silvics, Range Research, and Forest Products; a State and private forestry group, the three Divisions of State-Forest Purchase and Regulation, Clarke-McNary Law State Cooperation, and Private Timberland Cooperation; an acquisition group, the two Divisions of Land Planning and Land Purchase; an operating and information group, the three Divisions of Operation, Personnel Management, and Information and Education; and an Emergency Conservation Work group, the three Divisions of Enrolled Training, Camp Program and Coordinating.

The 10 regional-office organizations were brought as nearly into line with the revised divisional set-up as the varying local situations and requirements permitted.

The Assistant Chiefs, except in Emergency Conservation Work, are not administrative officers interposed between the Chief and his Division Chiefs, but true assistants who handle much of the work that of recent years has come to the Chief in person. The Forest Service is thus better able to handle its enormously increased activities without fundamental change in its organizational structure.

FIELD OF WORK

The Forest Service is primarily a field service, with work going on throughout the continental United States and in Alaska and Puerto Rico. This field work is administered through a decentralized territorial form of organization. Ten regional offices direct all of it except research, which is independently directed from 12 regional forest experiment stations and the Forest Products

Laboratory. Superimposed on both territorial organizations, however, is another form of organization under which the work is functionalized along uniform lines corresponding with the Washington office set-up.

The latter subdivides the field of work of the Forest Service on the basis of subject matter. The central purpose, of course, is to obtain the best possible use of the forests and forest lands of the entire United States, and of their products and services, in the interest of the general welfare. For this the first requisite is adequate knowledge. The progress of the year in this part of the field is set forth in the section of this report entitled "Research."

In size and cost an outstanding task of the Forest Service is national-forest administration. Closely allied are the activities concerned with land planning and Federal land purchases. In part, objectives sought in this field and the performance of the year in it have already been reported upon; in part what was done is covered under the heading "National-forest administration."

Bringing about better use of forest resources which do not call for Federal ownership, another major task, is sought principally through the work of the group of divisions concerned with State and private forestry, reported upon under this designation further on. Two other parts of the organization, however, contribute to the same end. One of these is as yet of temporary character; it conducts the activities of the Forest Service having to do with the Civilian Conservation Corps, both on national forests and on State and private forest lands. The second conducts informational and educational activities in promotion of better forest use throughout the country. It is one of several divisions mentioned in the preceding section which perform services contributory to the functioning of the entire organization. A description of their work follows.

THE FACILITATING DIVISIONS

The Division of Fiscal Control is responsible for seeing that Government funds appropriated for or allocated to the Forest Service are expended only for authorized purposes in accordance with applicable laws and regulations and in conformity with the interpretations and decisions of the Comptroller General. It is responsible also for the collection and proper disposition of all amounts due the United States on account of the sale of products of national forests and other sources of national-forest revenue. These duties include adequate accounting for all appropriation and receipt funds, examination of all expenditure documents, continual audit and inspection of the records of field units, and corrective action necessary to prevent improper use of Government funds or property. The Division also furnishes advice to the various units of the Forest Service as to the legality or permissibility of contemplated administrative policies, orders, and instructions which involve fiscal, legal, and procedural questions and in connection with proposed contracts involving the expenditure or receipt of money. A subunit of the division is maintained in each of the 10 regions, and at the Forest Products Laboratory. The regional fiscal offices are responsible to the Chief of Division for determining currently in the field that all Government moneys are properly expended and accounted for and collections effected, and for the audit and inspection work necessary to accomplish these purposes.

The Division also has charge of the cost-accounting system of the Forest Service; of all property accounting; and of the preparation of cost statistics, miscellaneous-expenditure statements, and many similar duties.

The Division of Operation is the agency through which the science of administration, as it is coming to be recognized, is applied over the entire range of Forest Service functions. The national-forest enterprise alone presents almost every problem of management found in the administration of a great industrial business. The Division is a central correlating agency, organized in Sections of Finance and Business Management, Administrative Statistics, and Equipment and Supply, with a specialist service in the fields of organization and production control.

The Forest Service financial budget is more complex than that of any other Bureau of the Department, necessitating a high order of financial management. In organization studies and planning of executive work the Forest Service has taken a leadership which has been recognized by industrial experts as outstanding in both Governmental and private industrial fields. The Section of Administrative Statistics assembles, computes, analyzes, interprets,

and presents to administrative officers in most usable form the mass of statistical data arising from and related to fire control, grazing, wildlife, recreation, private forestry, and other activities. The Section of Equipment and Supply has a complex task and a wide range of work, which creates unusual opportunities for increasing the economy and effectiveness of effort. The Section coordinates the equipment and supply service with that of the Department and the general supply sources of the Federal Government; contacts and keeps in touch with developments in the equipment and supply field; standardize and coordinates as between the far-flung field units of the Forest Service supervises supply depots, and heads up a radio laboratory and service which designs, develops, and provides radio equipment for the 1,150 radio stations now being operated by the Forest Service.

The Division of Personnel Management is a planning, coordinating, and directing agency which facilitates the work of all parts of the Service, but especially of the field units. It functions in techniques, procedures, forms and records; in the recruiting and placing of new employees; in all phases of training; in maintaining and increasing morale, and in helping to make the Service a satisfying organization in which to work. It aims to raise the level of Forest Service efficiency by bringing about a more skillful and intelligent dealing with the human material through which all tasks are accomplished. The Forest Service organization now includes personnel in 794 administrative units in 39 States. This decentralization makes necessary wide latitude for independent decision and action. Even temporary guards and firemen must, for example, often make decisions as to the application of fire suppression techniques involving the safety of large values. And much of the work is hazardous. These conditions create special problems in selecting, training, and caring for employees, and necessitates that the problems be given adequate and specialized attention.

The Division of Information and Education is organized in three sections. The Section of Programs plans, coordinates, and programs all informational and educational activities. The Section of Education prepares and distributes technical and educational material for foresters, users of forest resources and managers of forest land, educational institutions and teachers, and study club and groups. It edits all popular publications of the Forest Service; compiles and writes bulletins and articles for educational use; prepares exhibits for display at expositions and other gatherings; directs the making and distribution of motion pictures and photographs; maintains the photographic collection; and provides or arranges for speakers or other participants at forestry and educational meetings. The Section of Information collects and disseminates forestry news and information, other than educational and technical matter, to the organization, the profession, and the general public; maintains an information room for the convenience of callers, and a press service; issues a periodical news digest for distribution to all Washington office personnel; edits and issues the Service Bulletin, an organ of internal information and a medium for discussion and interchange of ideas for the entire personnel of the Forest Service; and will edit and publish the Forest Worker, for free distribution to forest schools and extension foresters and for paid subscriptions, carrying general news of the forestry profession, lists and reviews of forestry literature, etc. The Section also cooperates with radio-broadcasting companies in presenting addresses and programs relative to forest-fire prevention and other activities, and directs the informational activities of the entire Forest Service.

Two other organization units of all-service character, though not ranking as divisions but administered as assignments respectively to the Division of Silvics in the research group and to the Division of Engineering in the national forest group, may most appropriately be described here—the library unit and the photography unit.

LIBRARY

Soon after the Forest Service was organized, a forestry library was established. Under the capable direction of the late Helen E. Stockbridge and her successors, it has become one of the world's leading libraries in its specialized field. Special efforts have been made to complete its files of early American forestry material and of early European journals and texts as well as to keep abreast of current forestry literature at home and abroad. Of late, relief funds have enabled the library to catalog a great mass of related material and to

render increasingly valuable aid to forestry agencies. A large number of special bibliographies to meet various emergency aids have been prepared, including the manuscript for two special bibliographies, one on American Forestry, prepared in cooperation with the forestry committee of the National Research Council, and the other on the range. In addition to a current literature list issued bimonthly, duplicate index library cards are prepared currently for use in the forest experiment stations and regional office libraries. An outstanding contribution, the Union Checklist of Forestry Publications, was completed last year. This lists all the forestry periodicals which have been issued in the United States, giving the name, date, place of issue, and other pertinent information, and also the location of repositories of these journals. This checklist provides authentic information on many little-known periodicals, and is of great value to libraries and students of forestry literature.

Another library service made possible by emergency funds is the translation into English of nearly 500 papers on various subjects published in foreign languages. The fields covered include nearly every phase of forestry. Many of these translations have been of immense help in connection with emergency forestry programs in stand improvement, shelterbelt planting, reforestation, erosion control, and the like. The languages translated include French, German, Dutch, Scandinavian, Italian, Spanish, Portuguese, Russian, Latin, Greek, Czechoslovakian, Polish, Hungarian, and Japanese.

PHOTOGRAPHY

The Forest Service has one of the best equipped photographic laboratories in Washington, and has photostat, blueprint, and multilith equipment in most of the regional offices. In addition to Forest Service work, most of the photographic work for the Resettlement Administration has been done in Washington and some of the regional offices.

The photographic work accomplished during the year comprised 995,904 square feet of blueprints, 558,179 square feet of blue-line prints, and 600,284 square feet of black-line prints; 173,213 square feet of Van Dykes; 30,596 square feet of solar bromide prints; 434,466 square feet of photostats; 100,013 square feet of map mounting; and 133,096 prints of photo views.

NATIONAL-FOREST ADMINISTRATION

The expenditures for national-forest administration, protection, improvement, reforestation, and extension are shown in detail on pages 57 and 58.

NATIONAL-FOREST PROPERTIES

On June 30, 1936, the gross area of the national forests was 197,434,517 acres, of which 31,455,826 acres were in ownership other than that of the United States, leaving the net area 165,978,691 acres—an increase of 2,668,689 acres. An additional 3,123,832 acres acquired under the Weeks law were within purchase units which have not yet been given a national-forest status. More accurate computations based on new survey data added to the gross area 21,820 acres in 6 national forests, and subtracted 26,941 acres in 15; while the changes shown in table 1 added 9,147,421 acres.

Most of the increase in area was brought about through proclamations giving national-forest status to five purchase units and incorporating five more in already-established forests. This added 7,741,567 acres to the gross area. The Apalachicola, Bienville, Black Warrior, De Soto, George Washington, Holly Springs, Jefferson, Kisatchie, Monongahela, and Ozark Forests were thus created or enlarged. Proclamations under authority of special acts of Congress added 780,147 acres to the Cache, Fremont, and Willamette Forests. By direct action Congress added 440,012 acres to the Medicine Bow (the Laramie Peaks addition), 41,704 acres to the Rogue River, and 442 acres to the Pisgah, the latter comprising a watershed purchased by the Public Health Service to safeguard the water supply of its hospital at Oteen. The remaining additions consisted of 59,124 acres acquired under special land-exchange laws, 85,117 acres acquired through donations, and 89 acres added by Executive order. The eliminations were to make enterable under the Trades and Manufacturing Act 10 small areas in Alaska, aggregating 141 acres, and to effect a minor boundary adjustment in the Black Warrior Forest.

TABLE 1.—National-forest additions and eliminations, fiscal year 1936

National forest	State	Additions	Eliminations	National forest	State	Additions	Eliminations
		<i>Acres</i>	<i>Acres</i>			<i>Acres</i>	<i>Acres</i>
Apalachicola	Florida	1 306,395		Kootenai	Montana	2 22,320	
Beaverhead	Montana	2 176		Lolo	do.	2 320	
Bienville	Mississippi	1 382,820		Malheur	Oregon	2 8,055	
Bitterroot	Montana	2 320		Medicine Bow	Wyoming	4 440,012	
Black Hills	South Dakota	2 240		Monongahela	West Virginia	1 1,007,752	
Do	Wyoming	2 200		Nicolet	Wisconsin	1 89	
Black Warrior	Alabama	1 362,819	640	Ozark	Arkansas	1 598,935	
Cabinet	Montana	2 40		Pisgah	North Carolina	4 442	
Cache	Utah	1 187,465		Rogue River	Oregon	4 41,704	
Chugach	Alaska	(1)	8	Do	do.	3 320	
Clearwater	Idaho	3 14,235		Shasta	California	2 636	
Coeur d'Alene	do.	3 240		Siuslaw	Oregon	2 80	
Deschutes	Oregon	2 160		St. Joe	Idaho	3 69,371	
DeSoto	Mississippi	1 212,820		Tongass	Alaska	(1)	13
Flathead	Montana	2 280		Umatilla	Oregon	2 17,690	
Fremont	Oregon	1 573,607		Wenatchee	Washington	3 160	
George Washington	Virginia	1 639,204		Do	do.	2 2,856	
Harney	South Dakota	2 160		Whitman	Oregon	2 5,671	
Holly Springs	Mississippi	1 462,040		Willamette	do.	1 19,075	
Jefferson	Virginia	1 2,130,855					
Kaniksi	Idaho	3 711					
Kisatchie	Louisiana	1 637,927		Total		9,148,202	78

¹ Made by Presidential proclamation or Executive order.

² Private lands acquired through exchange.

³ Made by donation of private lands.

⁴ Made under acts of Congress.

The new national forests created during the year were the Apalachicola, the Bienville, the De Soto, the Holly Springs, and the Jefferson. The Alabama National Forest was redesignated the Black Warrior. The Unaka National Forest and 76,114 acres from the George Washington Forest were incorporated in the Jefferson, while 72,934 acres from the Monongahela were transferred to the George Washington. By a series of proclamations (some of which were not signed until after the close of the year) the boundaries of eastern national forests and purchase units which extended into two or more States were readjusted so that no eastern forest now lies in more than a single State. The new arrangement simplifies State relations, records and accounts, and payments to counties, and is otherwise advantageous.

As has been repeatedly pointed out in former reports, there have been pending for years numerous proposed additions to national forests in the Western States where every applicable circumstance dictates administration in common with the contiguous national forests. There exist many similar situations not covered by specific project reports, but where national-forest management would be equally sound, economical, and effective. Such areas should be added to the national forests without delay, and the advisability of further additions should be explored.

LAND ACQUISITION THROUGH EXCHANGE

Few natural units of forest management within national forests are now completely owned by the United States. Interspersed among the Federal holdings, or adjoining them, are millions of acres of lands in other ownerships and thus subject to different conditions of management, use, and hazard. This situation prevents application to the public properties of the best principles of management and development, and adds greatly to costs of protection and administration. Economies resulting from Federal acquisition of such private or State holdings would materially or completely offset the cost of acquisition.

One means of acquiring such lands is to grant in exchange therefor not to exceed equal values of national-forest land or stumpage, or both. This procedure has been authorized by 59 separate acts of Congress, the most recent being that of June 19, 1936, which extended the principle to certain areas adjoining the Umatilla and Whitman Forests in Oregon. Few owners of private lands wish to exchange them for other lands, the majority preferring national-

orest stumpage which can be liquidated by operation or sale. But as 25 per cent of the gross cash receipts from national forests goes to the counties, their income from this source is diminished when salable stumpage is used for exchange purposes. For years the Forest Service has restricted the value of stumpage granted in exchanges to one-tenth of that sold for cash in the same State and fiscal year. This self-imposed rule markedly limits the rate of progress otherwise possible in consolidating the national forests through exchanges.

Substantial progress was made in perfecting the details of pending exchanges with the States of Colorado, New Mexico, and Michigan, but no State exchange was consummated during the year. The Michigan exchange involves lands within State forests, purchased by the United States for conveyance to the State in exchange for equal values of State lands within the national forests. Under this arrangement, both classes of public forests will be consolidated and increased in public value. A similar course may be possible in other States which have acquired large amounts of forest land through tax reversion. The Colorado project would place the State in possession of a 70,000-acre tract susceptible of technical forest management; while the New Mexico exchange would vest the State with ownership of unreserved public lands valuable for range use, in lieu of forest lands within or adjacent to national forests and most economically administered as parts thereof.

During the fiscal year 81 specific private-land exchanges conveyed to the United States 116,939 acres, valued at \$355,897. In lieu thereof the United States granted 22,992 acres, valued at \$34,677, and 88,985,000 board feet of national-forest stumpage with a total appraised value of \$228,380; the net gain in national-forest area thus being 93,947 acres. In the same year the Secretary of Agriculture approved and referred to the Secretary of the Interior for further action 85 cases, involving 234,890 acres of private lands valued at \$787,603, 50,879 acres of national-forest land valued at \$207,866, and national-forest stumpage valued at \$396,344.

Exclusive of exchanges with certain of the States under the act of February 28, 1891, from the inception of the procedure to June 30, 1936, a total of 1,197 exchanges vested in Federal ownership 1,849,024 acres valued at \$6,664,966, for which the Government has granted 479,219 acres valued at \$2,052,083 and 1,393,174,000 board feet of national-forest stumpage valued at \$3,687,308. The net result has been to enlarge the national-forest area by 1,369,805 acres, to increase the volume of national-forest stumpage eventually available for economic uses, and markedly to simplify and reduce the cost of national-forest protection and management.

ACQUISITION OF LANDS THROUGH PURCHASE

Widening recognition of the many permanent benefits of Federal management of forest lands is attested by the fact that 34 States and Puerto Rico have now granted consent to Federal forest-land purchases within parts or all of their territories. Notwithstanding the difficulties attendant upon the unprecedented acceleration of the national-forest acquisition program, the only critical adverse reaction of substantial nature has arisen from uncertainty as to how withdrawals of lands from private ownership and taxation will affect county finances. This is now receiving special study to develop sound principles of fiscal relationship between the Federal Government and the counties.

The desirability of Federal acquisition of large bodies of operable commercial timber which otherwise would be subject to early exploitation seems unquestionable. In such cases Federal ownership and management assures permanent local and general benefits. Numerous natural units of timber operation could readily be placed on a sustained-yield basis, helping to stabilize communities and the existing social, industrial, economic, and political structure, were the owners not subject to strong pressure for liquidation of their timber investment. By acquiring that portion of the stumpage which private management cannot permanently carry, the Federal Government can substitute sound economic timber utilization for the uneconomic procedures which otherwise seem inevitable. This will require greater initial Federal investments than would be necessary to take over larger areas of denuded lands and restore them to productivity, but on the basis of comparative benefits and returns, the ultimate net cost will actually be lower.

During the year approval was given to the establishment of six additional purchase units, namely, the Grand Lake in Maine, the Northern Redwood and Southern Redwood in California, the Wasatch and Uinta units in Utah, and the Arrowrock in Idaho. Purchases also were authorized in the Sequoia and Tahoe National Forests in California. Certain combinations or revisions of established units also were approved. At the end of the year there were 88 defined areas, distributed throughout 30 of the States and Puerto Rico, in which forest-land purchases under the Weeks law had been sanctioned by the National Forest Reservation Commission. While the proposed program, as defined by this system of purchase units, is thoroughly sound, it has progressed beyond currently available means, so that in 11 of the units lack of funds made purchases impracticable and in 14 other units less than 20 percent of the purchasable lands have as yet been approved for purchase; so that Federal management is not thoroughly effective and economical. Early acquisition of additional lands in these units is highly desirable.

By Executive order dated August 1, 1935, the President allotted an additional \$12,000,000 for forest-land purchases under the provisions of the Weeks law thus bringing to a total of \$46,383,500 the funds made available for that purpose by the present administration. Inability to consummate certain approved cases not determined until the funds had ceased to be available for other purchases resulted in recisions of \$1,840,000 of the allotted money, reducing the total to \$44,543,500. That sum is 76 percent greater than all of the appropriations for acquisition from 1911 to 1932, and has permitted two and one-half times as much land to be acquired as during the preceding 22-year period.

During the year the National Forest Reservation Commission held eight meetings, at which it considered and approved for purchase 2,891,939 acres of lands at an aggregate purchase price of \$11,601,644. The total approved since March 1933 has been 11,609,198 acres, costing \$38,058,701. This brings the grand total approved since 1911 to 15,945,273 acres, at a cost of \$59,478,068. The acreage vested in Federal ownership by final payment and recordation of deed during the year aggregated 3,489,457 acres; the total acreage now so acquired is 10,789,534 acres. In addition to the lands acquired by purchase, the Government holds within the same areas 2,557,758 acres reserved from the public domain, and 241,807 acres acquired by exchange; so that its complete holdings within the purchase units aggregate 13,589,100 acres, with an additional 5,155,738 acres in course of purchase.

ACQUISITION OF LAND THROUGH DONATION

As was shown in table 1, the national-forest area was appreciably enlarged by donations of lands, aggregating 85,117 acres and bringing the total of lands donated to 240,929 acres.

Counties to which lands have reverted through tax delinquency regard with increasing favor the idea of conveying such lands to the United States for permanent forest management. Under this course the residual values of the lands are conserved, improvements indispensable to their protection and use are installed, destructive fires are prevented or suppressed, and the utilization of the remaining resources is controlled, all to a degree that would not be practicable under the financial and legal limitations to which the counties are subject. The increased acreage of national-forest land qualifies the county for proportionately increased shares of national-forest revenues and road expenditures. Similarly, private owners of forest lands are increasingly recognizing that if their cut-over lands are donated to the United States their remaining timbered lands, sawmills, railroads, and the like will benefit by the more effective protection, development, and management that will ensue; while greater permanency will be given to the enterprises and community values in which they are directly interested. For these reasons, donations promise to be progressively important means of consolidating and extending the public properties.

SPECIAL USES

At the close of the fiscal year 39,367 special-use permits were in effect, as against 38,683 at the close of the previous fiscal year. They comprised 18,269 issued without charge and 21,098 involving an annual rental.

CLAIMS AND SETTLEMENT

During the fiscal year 47 favorable and 5 unfavorable reports were made on applications for homestead patents, and 29 favorable and 42 unfavorable reports on applications for mineral patents.

COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

The physical characteristics of national parks and national forests are in many ways similar. Both embrace interesting and sometimes unique geological and organic examples of the operation and effect of natural laws, possessing high inspirational, educational, and recreational values. The basic difference relates to the form of administration through which the American people can derive from a given area the maximum social and economic benefits.

Sometimes the intrinsic values involved justify maintaining the area inviolate as a permanent "museum piece" deserving of national concern, and demand its administration exclusively as a source of scientific knowledge, education, inspiration, and recreation. In other cases the best public interest may require that the area be so managed as to derive from it a coordinated series of benefits and uses, proper balance being maintained between the intangible services of scientific, spiritual, and recreational character and the tangible services to industry, commerce, and the general economy. A national-park status appropriately may be given to the "museum" areas, but not to areas where the principles of management most in the public interest are incompatible with those necessary for national parks truly meriting the name. Otherwise, national-park administration and national-forest administration would lose their basic difference and become duplicating activities.

Unsettled questions of boundary adjustments between national parks and national forests therefore find their origin in economic rather than administrative circumstances, and should be determined accordingly. Against the benefits to be derived by placing a given area in a national park there must be weighed the social and economic losses which that action might impose upon both the local and more remote populations. If careful study and analysis of all factors show the national-park status to promise the highest and most permanent social benefit, the status should be promptly established. Otherwise, it should not be. Principles are involved, not a mere jurisdictional rivalry. There should be no compromise that would break down the standards and the principles of management which distinguish national parks from national forests. This viewpoint has guided the Forest Service in all of its actions and recommendations relating to transfers of lands from national forests to national parks.

The only bills before Congress proposing transfers of lands from national forests to national parks were those carried over from the preceding year, relating to the Kings River area in California, the extension of the Grand Teton National Park in Wyoming, and the establishment of the Mount Olympus National Park in the State of Washington. The Congress did not act in any way on the Kings River and Grand Teton bills. The bill to establish the Mount Olympus National Park was the subject of an extended and exhaustive hearing before the House Public Lands Committee, but was not enacted into law. A number of other proposals by the National Park Service received continued attention from the Forest Service during the year, but none was carried to the stage of final agreement between the two agencies.

NORTHERN PACIFIC LAND GRANT ADJUDICATION

The suit to adjudicate the equities of the Northern Pacific Railroad Co. under the land grant of July 2, 1864, the resolution of May 31, 1870, and later amendments thereof, as authorized by the act of June 25, 1929, continued to receive attention throughout the year; the Department of Justice representing the United States in the legal phases, the Forest Service cooperating in the collection of essential information. A preliminary decision by the master hearing the case, confirmed by the Federal district judge, required the initiation of additional field activities to determine accurately the valuations of the controverted lands. Under an act approved May 22, 1936, provision is made for direct review by the Supreme Court of the United States by appeal by any party to the suit, which will permit final adjudication of points of law and simplify the determination of the elements of value.

PROTECTION FROM FIRE

For the national forests as a whole the 1935 fire season was less severe than that of 1934, which was coincident with one of the greatest drought seasons of modern times. During the fire season of 1935 the Forest Service fought and controlled 10,689 fires, which is only slightly less than the number fought in 1934, but 2,013 more than the average annual number over a 5-year period.

The 1935 total of 168,394 acres of national-forest land burned was only 4 percent of the 5-year average, and only 30 percent of the area burned over in the bad year 1934.

In certain parts of the country an unusually fine fire record was made, but in other sections, such as southern Idaho, Montana, and Wyoming, critical conditions existed late into the season because of the continued adverse weather conditions. In these areas of high fire danger, it was only by careful planning and early action that very disastrous conflagrations were in many instances avoided. In the northern Rocky Mountain region the total number of fires was greater than in 1934, due very largely to heavy concentrations of lightning fires. In this region the peak 10-day load was 472 fires in the last third of July, and in most instances the fires were started in areas where the forest cover was the most inflammable. In this region, as others, rains in late July and August materially aided the continuous efforts of the control forces.

As in years past, the availability of Civilian Conservation Corps help was of the greatest value.

In the central Rocky Mountain region only two large fires occurred. These were in Wyoming. There was no Civilian Conservation Corps camp adjacent to the forest upon which one of these occurred. On the other forest the number of Civilian Conservation Corps men available was somewhat below that required. The record of fire suppression in Arizona and New Mexico was exceptionally good, and in this instance it was also due largely to the readily available forces of the Civilian Conservation Corps under trained forest officers.

The heaviest losses in the West occurred in the intermountain region, principally in southern Idaho. The precipitation during the 4 months beginning June 1 was only 30 percent of normal. In the northern part of this region the dry, hot conditions were equaled only in the outstandingly bad fire years of 1910 and 1919. In California the season was the most favorable since 1927, and the acreage burned the lowest in many years. Although this can be attributed partly to the favorable weather conditions, high hazards existed at times, and the main credit can be given to a more efficient and better trained organization.

In the north Pacific region one-third more lightning fires occurred than the average for the past 10 years. The man-caused fires, however, were fewer than in 1934, and the number of incendiary fires was only about one-half the number in 1934. The most dangerous fire of the season in this region, and the most difficult to handle, occurred on the Willamette National Forest in early September. It was of incendiary origin, and developed quickly into a crown fire which spread very rapidly over an area of rough topography but was successfully corralled a few days later. In this fire, as in many of the others which occurred during the season, the value of the radio instruments and systems which have been developed in the Forest Service played an important part. Communication was established between all camps, and scouting was conducted by airplane. Through the radio the fire chief was in touch with the various crews and scouts at frequent intervals, and the time of getting the fire under control was shortened materially.

Of the acreage burned in the South, 67,000 acres were on four newly acquired units in neighborhoods where the residents have not yet learned the lesson of care with fire.

Table 2 shows the 1935 fire record in comparison with that of 1934, and the 5-year average for 1931-35.

Several important factors are contributing to increasingly greater fire danger in the national forests. As transportation facilities are extended and ownership of motorcars increases annually, and forest areas are made more desirable for summer recreation, many thousand more visitors are attracted. Since more than half of all fires on national forests are man-caused, this element of risk is a serious one. For 20 years (with the exception of the years 1923 and 1927) there has been an unbroken record of rainfall deficiency. This, to an unknown degree, builds up an accumulated dryness, making for increased inflammability of vegetative cover.

TABLE 2.—Comparison of fires on national forests, calendar years 1935, 1934, and 5-year average, 1931-35

Item	Fires			Percentage of total		
	1935	1934	Average 1931-35	1935	1934	Average, 1931-35
Loss:	<i>Number</i>	<i>Number</i>	<i>Number</i>			
Burns of 0.25 acre or less.....	5,946	6,023	4,883	55.63	55.40	56.28
Burns of between 0.25 and 10 acres.....	3,078	3,139	2,413	28.79	28.88	27.81
Burns of 10 acres and over.....	1,665	1,709	1,380	15.58	15.72	15.91
Total.....	10,689	10,871	8,676	100.00	100.00	100.00
Cause:						
Railroads.....	225	239	162	2.11	2.20	1.87
Lightning.....	4,031	4,773	3,344	37.71	43.91	38.54
Incendiarism.....	1,389	1,118	1,185	12.99	10.28	13.66
Debris burning.....	775	550	472	7.25	5.06	5.44
Lumbering.....	267	116	123	2.50	1.07	1.42
Campfires.....	920	991	870	8.61	9.11	10.03
Smokers.....	2,545	2,582	2,075	23.81	23.75	23.91
Miscellaneous.....	537	502	445	5.02	4.62	5.13
Total.....	10,689	10,871	8,676	100.00	100.00	100.00
Calendar year	Total area of national-forest land burned over		Total damage of national-forest land burned over	Total cost of fighting fires exclusive of time of forest officers		
	<i>Acres</i>		<i>Dollars</i>	<i>Dollars</i>		
1935.....	168,394		336,145	1,325,979		
1934.....	555,309		1,720,365	3,175,543		
5-year average, 1931-35.....	352,317		1,320,373	2,096,749		

Of this amount \$544,213 was Emergency Conservation Work and Emergency Relief Administration funds.

Of this amount \$1,040,507 was Emergency Conservation Work funds.

These influencing factors are being met and to a large extent offset by continuous improvement in the fire-control organization and the perfecting of the techniques of preparedness and fire fighting. During 1935, systematized training was extended to a greater portion of the temporary and permanent personnel and made more complete and intensive. The enrollees and supervisory personnel of the Civilian Conservation Corps located in forested areas were given more thorough and practical training in fire fighting. Communication in fire fighting was greatly speeded up by the addition of many more of the portable radio sets developed by the Forest Service.

Intensive surveys and studies were conducted in regard to the character and distribution of the various types of forest fuels and the other elements which make up the sum of fire danger. Application of the results of these studies brought about better placement of men and equipment. Continuation of the studies of lookout coverage and of the communication and transportation systems revealed opportunities for revision and addition. In all regions the construction program conforming to these plans enabled the suppression forces to reach fires earlier and confine them to smaller acreages than has been possible under similar conditions in the past.

Airplanes were used more extensively for the transportation of men and supplies, and in all cases lessened the elapsed time between the start of fire and the arrival of fire-fighting forces. In 1935 772 men and 216,400 pounds of freight were transported by airplane. Planes were used frequently for scouting and reconnaissance in order to secure a clearer perspective of the fire and to make the movement of large fires and shape the plan of attack. Motor-driven fire-line-building and trench-digging equipment, including tractors, plows, bulldozers, and brush-breaking accessories, were put in the field. A meeting held in Spokane, Wash., in February 1936, attended by the fire-

control specialists of all regions, was of great assistance in assembling a present knowledge and experience in fire-control techniques and equipment. Standards were adopted which will bring about a closer approach to objective.

Perhaps the largest and most important contribution the Civilian Conservation Corps has made during the 3 years of its existence has been in protecting the forests from fire. From April 1, 1933, to April 1, 1936, for the country as a whole, a total of 2,521,604 man-days had been put in by the Civilian Conservation Corps in fighting forest fires. In addition to actual fire fighting the Civilian Conservation Corps has made heavy contributions to fire prevention and fire presuppression by constructing firebreaks, reducing fire hazards, and cleaning up roadsides and trailsides, as well as making heavy contributions in the construction of protective improvements such as telephone lines, fire lookout towers and houses, and truck trails.

THE 1936 FIRE SEASON

The forest-fire situation of 1936 to the date of this report (Sept. 1) shows more than usual geographic and seasonal variations. The southern forests east of the Mississippi and those in Arkansas and southern Missouri suffered most in March and April, before the growth of the spring foliage. During this period the days of critical fire danger greatly exceeded the normal number and by May 1, 5,000 fires had burned over approximately 175,000 acres. The reasons were a deficiency of spring rainfall, the deep-rooted local custom of wood burning, and the relative newness of preventive and protective effort.

In the western regions the fire season, as usual, did not open until June. Through July and August the forests of Montana, northern Idaho, Wyoming, the Dakotas, Minnesota, Wisconsin, and Michigan were subjected to unprecedentedly high temperatures, high winds, and low humidity (the great 1933 drought), with an unusually large number of lightning storms. Although the number of fires in these high-hazard forests was about one-fifth greater than the 5-year average, the fire-control organizations held the area burned to about one-half the 5-year average and about one-third that of the comparable drought year of 1934. During this period the forests of the Southwest, the southern Rocky Mountains, and the Pacific coast enjoyed normal and even favorable weather conditions, and although slightly more than the average number of fires occurred, the area burned was held to about one-fourth of the average area. The weather helped, but mainly the outcome reflected experienced and efficient fire control.

To the date of this report (September 1) the loss of firefighters' lives in the 1936 fire season was as follows: Employees other than Civilian Conservation Corps enrollees, Sawyer R. Brockunier, Cameron A. Baker, and John Rolles on the Lewis and Clark Forest, Wilko Aronen on the Kaniksu, and Gerald E. McDonald on the Superior; Civilian Conservation Corps enrollees, Archie M. Murphy in Wyoming and Norman J. Atkins in Oregon.

PROTECTION FROM TREE DISEASES AND INSECTS

The Forest Service looks to other bureaus of the Department of Agriculture to furnish the technique of control in protecting the national forests from forest pests and cooperates very closely with these bureaus in the actual operations. The Bureau of Entomology and Plant Quarantine advises on control methods for blister rust disease and forest insects, the Bureau of Biological Survey on rodent control, and the Bureau of Plant Industry on tree diseases, particularly those encountered in the growing of planting stock.

Less advance was made in the control of white-pine blister rust during the calendar year 1935 than in 1934, but more than in 1932 and 1933. The total area worked on the national forests was 228,000 acres, of which 138,000 acres were in the western white pine region, 49,000 acres in the sugar pine region, 33,000 acres in the northern white pine region, and 8,000 acres in the central Rocky Mountain region. The latter represents experimental work on limber and whitebark pine areas.

The blister rust disease attacks all of the eight native species of white pine found in the United States, but by far the major control problem on the national forests is in the West, where 2,500,000 acres need protection. Of this 1,392,000 acres are in northern Idaho, western Montana, and eastern Washington, the home of the valuable western white pine; 746,000 acres have been covered so far. In California, where grows the highly valuable sugar pine, the

largest of the white pines, 1,108,000 acres need protection; it has as yet been applied, however, on only 187,500 acres.

In the Northeast most of the present white pine stands are outside the national forests, and blister rust control has been pretty well established through cooperative efforts between the Bureau of Entomology and Plant Quarantine and the private owners. Pine areas within the national forests in this region have been protected. Rather extensive stands of white pine are found in the national forests in the southern Appalachians, but the relative infrequency with which the alternate host plants (*Ribes*) of the blister rust occur in the white pine zones makes control comparatively simple. Nor has control been very difficult or costly, as a rule, in the Lake States national forests, where white pine occurs extensively.

White pine is planted on the national forests only on sites preeminently suitable to white pine and relatively free of currants and gooseberries. If any *ribes* bushes occur, they must be eradicated before the planting.

In general, bark beetle epidemics on the national forests in 1935 were not so severe as in 1934. The 1935 season was the most favorable for tree growth in several years and the resulting increased vigor of the trees made them better able to resist bark beetle attacks. A considerable part of the 1935 funds available for insect control was devoted to an extensive survey to discover localities in which prompt action on a beginning infestation might head off the building up of serious epidemics.

Bark beetle control work was continued on a stubborn infestation of mountain pine beetles in southern Idaho and northern Utah, treatment being given 14,964 trees on the Cache, Minidoka, Uinta, Wasatch, and Ashley National Forests. This outbreak has been active for a number of years but is believed to be now reduced to an endemic condition. In California, in contrast to the situation reported last year, a return to normal conditions is indicated on most of the national forests. The infestation of the western pine beetle in east-side ponderosa pine stands on the Modoc, Plumas, and Lassen National Forests seems to have passed its peak; with minor exceptions, endemic conditions prevail in the west-side ponderosa pine; and timber losses from the mountain pine beetle in sugar pine stands were at the lowest level reported during the past decade. A total of 6,723 trees were treated on the national forests of California—50 percent less than last year.

A careful survey of the entire ponderosa-pine type in Oregon and Washington disclosed that during the 5-year period 1931-35 the volume of ponderosa pine killed by bark beetles was only slightly less than the volume commercially harvested. Present indications are that the situation will be materially improved in 1936, following a more than average precipitation during the first months of 1936 for most of the pine areas and a heavy freeze in October and November of 1935 in many parts of eastern Oregon, which is estimated to have killed from one-third to one-half of the beetle larvae. A total of 5,469 trees were treated in 1935 on the national forests in Oregon.

Vigorously pushed work in Colorado and Wyoming in 1935 brought under control two large and a number of small infestations which have shown threatening tendencies. The Black Hills beetle infestation on the Montezuma, Uncompahgre, and San Juan National Forests in southern Colorado, which had been fought for 3 years, was finally cleaned up and is now on a maintenance basis. In the Medicine Bow National Forest, Wyo., the mountain pine beetle infestation in lodgepole and limber pines, which for several years has been threatening extensive stands of valuable tie timber, was brought to an endemic condition. This infestation was made up of many scattered patches of trees heavily attacked by beetles, and it was feared that an epidemic was building up similar to that which swept across the Beaverhead, Bitterroot, and Madison National Forests in Montana and the Targhee National Forest in Idaho some two years ago, and which reached such dimensions that control was impossible. A total of 29,529 trees in Wyoming and 27,152 trees in Colorado were treated. June bugs continue to be a source of trouble in connection with reforestation in the Lake States. The plan of carefully testing all planting sites in advance proved a valuable aid in reducing losses. The construction of deeper and wider furrows in preparing areas for planting has also proved an effective control measure. This improved technique and a return to more normal conditions of precipitation made the loss of trees in plantations from beetle damage much less in 1935 than for several years past.

PHYSICAL IMPROVEMENTS

Most of the national forests are located in the mountainous regions of the country and are largely undeveloped and inaccessible. To facilitate their administration and insure their protection it is necessary to provide them with various kinds of physical improvements for transportation, communication and habitation. Telephone lines are built for forest-fire control and the conduct of official business in sections where commercial systems do not exist. In certain areas where telephone lines do not exist or are not feasible, special radio sets and stations have been developed by the Forest Service to augment the protection communication system. Lookout cabins to house men and instruments are properly located and built to insure prompt discovery of fires and to transmit the alarm. Where the topography does not provide natural elevation sharp enough to command the necessary view, lookout towers are erected. Dwellings, offices, barns, and other buildings necessary to provide quarters for men and animals and to house motor and other equipment and supplies are built. Water-supply systems involving spring development, wells, small pumping plants, pipe lines, and other works are provided at ranger stations and other quarters. To encourage public recreational enjoyment of the forests, and as a fire-preventive measure, selected campgrounds are cleaned up and improved with water and sanitary systems, fireplaces, tables, and other simple facilities.

Many improvements of a nonstructural nature are required to promote sure and speedier forest-fire control. Wide lanes, known as firebreaks, are cleared of vegetation along ridges and other strategic locations to stop fires and to aid in control activities by permitting the free movement of men and backfiring. Fallen timber and litter along the roadways are cleared to reduce the fire hazard. In remote sections small selected areas are cleared and leveled for use as airplane emergency landing fields, to permit transportation of men and supplies. Table 3 shows the construction work of the year, and the total to date on improvements for administration and protection.

TABLE 3.—Construction of physical improvements to facilitate protection and administration to June 30, 1936

Type	Constructed during the fiscal year 1936	Total constructed to June 30, 1936
Telephone lines.....miles.....	4, 671	54, 6
Radio-communication sets.....number.....	466	1, 1
Public campgrounds.....do.....	282	3, 7
Airplane landing fields.....do.....	6	
Firebreaks.....miles.....	1, 930	10, 4
Buildings:		
Lookout houses.....number.....	114	1, 6
Lookout towers.....do.....	155	1, 1
Offices.....do.....	111	5
Dwellings.....do.....	230	3, 2
Shops and warehouses.....do.....	143	8
Miscellaneous.....do.....	1, 026	9, 2

ROADS AND TRAILS

A transportation system is essential to the multiple activities involved in the protection, administration, utilization, and development of the national forest. This system is carefully planned and is used as the basis for the selection of construction projects. Only projects shown upon the approved transportation system are undertaken.

The sources of funds for the construction of forest roads and trails which are regularly made available each year were, for the fiscal year 1936:

(1) The 10-percent fund, known as the "Roads and trails for States, national forest fund", made available annually in accordance with the provisions of the Agricultural Appropriation Act of March 4, 1913.

(2) Forest road and trail fund, composed of the forest-highway and forest road development funds, appropriated under the provisions of section 23 of the Federal Highway Act of November 9, 1921.

(3) Cooperative funds, provided mostly by the States and totaling \$596,320, of which approximately \$405,732 was expended upon forest highways; the rest was used for minor forest road and trail projects.

The contributed time of agencies other than the Forest Service, mostly the Civilian Conservation Corps, evaluated at \$39,978,431, was used for the construction and maintenance of truck trails and trails on the planned transportation system.

The transportation system as proposed for the national forests is shown in table 4. The forest highways are roads necessary to the forests but required primarily for public travel, while the forest-development roads and trails are required primarily for the protection, administration, development, and utilization of the forests. Tables 5, 6, and 7 show, by States, the miles constructed and maintained and the expenditures and apportionments of the various roads funds; and table 8 shows the condition of these funds at the close of the fiscal year.

TABLE 4.—*Classification of mileage in forest road and trail system, and expenditure required to complete the system to a satisfactory standard, June 30, 1936*

Class	Total	Satisfac- tory standard	Unsatis- factory standard	Nonexist- ing	Expendi- ture re- quired to complete
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Dollars</i>
Forest highways.....	23,380	12,099	9,821	1,460	287,511,000
Forest-development roads.....	102,569	44,940	28,913	28,716	96,751,200
Total.....	125,949	57,039	38,734	30,176	384,262,200
Trails.....	154,228	119,838	17,348	17,042	4,750,500
Total.....					389,012,700

TABLE 5.—*Construction, improvement, and maintenance of roads and trails, from forest road appropriations and other federal and cooperative funds, by States, June 30, 1936*

State	Fiscal year 1936				Total constructed to June 30, 1936		Expenditures to June 30, 1936		
	Constructed		Maintained		Roads	Trails	Federal funds ¹	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails					
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Ala.....	50.2	-----	206.7	2.0	167.5	-----	1,368,157.23	25,278.16	1,393,435.39
Alaska.....	13.2	39.8	259.7	248.0	288.5	868.0	8,924,296.31	329,262.27	9,253,558.58
Ariz.....	255.9	160.	54,395.5	2,708.0	3,517.2	2,288.6	14,807,803.71	1,222,083.67	16,029,887.38
Ark.....	208.4	-----	1,853.4	914.0	1,684.2	571.4	7,112,409.13	135,929.75	7,248,338.88
Calif.....	733.5	106.9	15,974.5	21,059.8	10,417.4	12,340.5	52,197,037.61	8,843,320.21	61,040,357.82
Colo.....	73.4	148.2	1,459.3	10,902.5	2,002.6	12,225.8	14,439,789.57	1,245,607.78	15,685,397.35
Fla.....	249.6	-----	814.7	-----	1,374.2	-----	2,368,434.53	146,179.84	2,514,614.37
Ga.....	160.0	2.2	447.7	222.5	476.9	862.1	3,021,601.89	82,949.62	3,104,551.51
Idaho.....	644.1	232.2	5,601.7	24,735.5	6,275.0	21,379.1	37,137,958.63	1,918,233.83	39,056,192.46
Ill.....	80.3	-----	184.9	-----	232.8	-----	1,646,264.15	184.28	1,646,448.43
Ind.....	2.3	-----	5.0	-----	2.3	-----	54,907.69	-----	54,907.69
Iowa.....	2.7	-----	30.0	-----	2.7	-----	72,086.45	-----	72,086.45
Kans.....	-----	-----	-----	-----	3.4	-----	2,111.51	-----	2,111.51
Ky.....	35.1	-----	420.0	-----	92.3	-----	1,696,779.32	-----	1,696,779.32
La.....	127.7	-----	390.0	-----	510.8	-----	814,236.30	-----	814,236.30
Maine.....	.5	.1	15.5	90.0	13.5	90.0	418,349.49	-----	418,349.49
Md.....	-----	-----	-----	-----	-----	-----	70.05	-----	70.05
Mich.....	505.1	-----	1,283.9	-----	2,366.9	-----	3,079,899.10	201,415.03	3,281,314.13
Minn.....	134.3	200.4	822.3	400.6	1,104.9	897.3	3,236,494.20	333,786.75	3,570,280.95
Miss.....	225.2	-----	636.9	-----	636.9	-----	3,089,533.03	-----	3,089,533.03
Mo.....	225.9	-----	441.5	-----	595.4	-----	2,180,312.70	-----	2,180,312.70
Mont.....	306.7	241.8	3,346.9	21,330.0	2,422.1	19,793.3	19,782,076.93	669,258.24	20,451,335.17
Nebr.....	1.6	-----	142.7	-----	116.7	-----	194,077.00	990.80	195,067.80
Nev.....	47.3	2.3	519.0	1,759.7	708.6	943.2	3,445,459.38	178,870.54	3,624,329.92
N. H.....	17.4	31.0	98.8	902.0	120.0	890.1	2,411,102.61	95,949.70	2,507,052.31

¹ Includes exact figures for road funds and approximate figures for Civilian Conservation Corps equipment rentals, and other Government funds for the current fiscal year.

TABLE 5.—Construction, improvement, and maintenance of roads and trails, from forest road appropriations and other federal and cooperative funds, by States, June 30, 1936—Continued

State	Fiscal year 1936				Total constructed to June 30, 1936		Expenditures to June 30, 1936		
	Constructed		Maintained		Roads	Trails	Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails					
	Miles	Miles	Miles	Miles	Miles	Miles	Dollars	Dollars	Dollars
N. J.							217.71		217.71
N. Mex.	187.1	55.8	2,522.7	3,364.3	2,351.5	1,773.1	11,000,458.06	336,457.32	11,336,915.38
N. Y.							81.32		81.32
N. C.	79.4	23.0	489.4	744.4	570.8	744.4	5,223,030.91	478,353.40	5,701,384.31
N. Dak.	1.2				2.2		4,355.25		4,355.25
Ohio	14.9		7.4		14.9		146,855.88		146,855.88
Okla.	46.6		167.8		148.9	16.5	760,115.17	17,065.09	777,180.26
Oreg.	226.2	77.2	11,075.3	15,915.0	7,046.2	9,874.7	32,133,557.64	8,343,004.67	40,476,562.31
Pa.	21.9	27.0	237.5	277.8	195.5	277.8	2,663,648.34	42,185.50	2,705,833.84
P. R.	4.0	7.0	8.4	54.6	12.4	61.6	932,877.33	550.00	933,427.33
S. C.	69.9		187.4	18.2	262.6	18.2	1,572,456.75	15,659.81	1,588,116.56
S. Dak.	46.9	8.0	270.2	48.7	486.9	108.1	2,016,134.83	241,605.27	2,257,740.10
Tenn.	131.0	31.2	435.0	654.5	504.6	728.0	3,972,862.00	197,596.61	4,170,458.61
Texas	159.3		257.1		257.1		1,311,838.39		1,311,838.39
Utah	203.1	122.9	1,658.0	3,285.1	2,299.2	4,086.5	9,075,404.58	1,024,017.35	10,099,421.93
Vt.	2.3	109.2	15.7	148.4	15.7	148.4	521,621.88		521,621.88
Va.	37.4	85.0	622.1	965.8	519.2	1,029.0	3,708,984.04	107,195.35	3,816,179.39
Wash.	190.0	128.8	3,755.6	14,069.4	3,264.6	10,011.0	21,117,123.92	1,735,320.15	22,852,444.07
W. Va.	41.7	83.0	472.4	758.4	492.9	762.2	3,014,459.63	38,159.30	3,052,618.93
Wis.	294.6		1,023.6		1,275.1		2,291,882.30	1,820.00	2,293,702.30
Wyo.	54.0	41.0	1,186.4	5,782.0	1,389.8	2,723.9	9,048,672.22	407,096.81	9,455,769.03
Total	5,911.9	1,964.5	63,742.6	131,361.2	56,242.9	105,012.8	294,017,386.69	28,415,387.10	322,432,773.77

TABLE 6.—Distribution among the States of the road and trail apportionments for the fiscal year 1937

State	Roads and trails for States, national-forests fund (10-percent fund)	Forest highways	Forest-road development	Total
Alabama	\$4.00	\$12,429.00	\$9,108.00	\$21,541.00
Alaska	7,715.94	653,324.00	14,457.00	675,496.94
Arizona	31,735.64	411,861.00	145,022.00	588,618.64
Arkansas	30,592.06	82,232.00	49,139.00	161,963.06
California	53,656.83	1,003,136.00	505,914.00	1,562,706.83
Colorado	45,314.44	516,878.00	146,686.00	708,878.44
Florida	8,159.40	35,130.00	29,456.00	72,745.40
Georgia	1,480.18	19,059.00	10,864.00	31,403.18
Idaho	44,611.84	723,624.00	459,856.00	1,228,091.84
Illinois	45.93	6,077.00	15,791.00	21,913.93
Indiana		1,646.00		1,646.00
Kentucky	153.59	11,052.00	7,090.00	18,295.59
Louisiana	152.14	14,073.00	10,472.00	24,697.14
Maine	184.43	2,282.00	1,037.00	3,503.43
Michigan	866.38	50,301.00	95,125.00	146,292.38
Minnesota	2,373.22	83,524.00	47,407.00	133,304.22
Mississippi	312.80	30,252.00	18,536.00	49,100.80
Missouri	103.49	25,987.00	34,062.00	60,152.49
Montana	22,136.57	566,409.00	276,139.00	864,684.57
Nebraska	836.32	6,793.00	7,950.00	15,579.32
Nevada	6,941.49	128,893.00	24,073.00	159,907.49
New Hampshire	3,276.25	38,257.00	10,026.00	51,559.25
New Mexico	10,819.44	288,788.00	120,138.00	419,745.44
North Carolina	2,884.15	36,729.00	16,968.00	56,581.15
Ohio		1,541.00		1,541.00
Oklahoma	2,366.18	5,966.00	5,009.00	13,341.18
Oregon	27,597.28	939,956.00	371,926.00	1,339,479.28
Pennsylvania	1,862.61	17,649.00	16,537.00	36,048.61
Puerto Rico	30.00	1,136.00	359.00	1,525.00
South Carolina	401.81	18,668.00	10,679.00	29,748.81
South Dakota	10,586.56	55,482.00	19,235.00	85,303.56
Tennessee	1,523.63	21,416.00	11,539.00	34,478.63
Texas	144.83	21,769.00	8,744.00	30,657.83

TABLE 6.—*Distribution among the States of the road and trail apportionments for the fiscal year 1937*—Continued

State	Roads and trails for States, national forests fund (10-percent fund)	Forest highways	Forest-road development	Total
Utah.....	14,499.46	234,924.00	79,831.00	329,254.46
Vermont.....	649.64	9,311.00	6,953.00	16,913.64
Virginia.....	1,715.58	37,984.00	42,056.00	81,755.58
Washington.....	39,882.82	514,924.00	189,106.00	743,912.82
West Virginia.....	493.71	27,344.00	34,126.00	61,963.71
Wisconsin.....	504.63	34,325.00	41,125.00	75,954.63
Wyoming.....	21,741.02	308,869.00	107,459.00	438,069.02
Total.....	398,356.29	7,000,000.00	3,000,000.00	10,398,356.29

TABLE 7.—*Distribution among the States of the total road and trail apportionments, including the fiscal year 1937*

State	Roads and trails for States, national forests fund (10-percent fund)	Cooperative construction, etc., of roads and trails, national forests (sec. 8 fund)	Federal forest-road construction	Forest highways ¹	Forest road development ¹	Improvement ¹	Total
Alabama.....	\$1,057.31	\$15,456.04	\$1,922.31	\$99,173	\$158,797	\$31,077.06	\$307,482.72
Alaska.....	187,677.88	470,963.60	203,229.50	8,635,350	363,891	—	9,861,111.98
Arizona.....	753,334.82	677,956.45	490,434.11	7,031,709	2,420,225	546,273.39	11,919,932.77
Arkansas.....	198,895.22	175,126.19	128,423.38	1,094,090	1,008,301	295,897.47	2,900,733.26
California.....	1,895,631.40	1,464,333.82	1,201,431.20	16,962,753	8,819,107	1,518,217.76	31,861,474.18
Colorado.....	927,202.77	770,948.34	784,259.55	8,403,867	2,637,543	197,297.57	13,721,118.23
Florida.....	60,330.09	119,528.14	21,534.94	393,162	250,995	140,417.47	985,967.64
Georgia.....	16,790.50	52,393.57	130,443.73	244,404	353,138	133,229.53	930,399.63
Idaho.....	1,128,879.09	1,176,750.85	1,337,004.17	12,471,627	10,180,854	1,827,886.55	28,123,001.57
Illinois.....	45.93	—	—	32,316	36,236	—	68,597.93
Indiana.....	—	—	—	1,646	—	—	1,646.00
Iowa.....	1,867.27	—	—	—	—	—	1,867.27
Kentucky.....	876.31	—	—	44,958	152,600	—	198,434.31
Louisiana.....	363.79	—	—	66,604	83,607	38,132.47	188,707.26
Maine.....	4,554.61	32.41	3,738.77	34,945	40,115	21,909.56	105,295.35
Maryland.....	70.05	—	—	—	—	—	70.05
Michigan.....	7,297.91	115.63	3,000.00	319,021	570,966	164,507.86	1,064,908.40
Minnesota.....	49,916.73	8,036.36	108,352.03	888,683	669,755	130,348.59	1,845,121.71
Mississippi.....	579.01	—	—	112,879	136,935	8,598.45	258,991.46
Missouri.....	103.49	—	—	74,278	82,903	—	157,284.49
Montana.....	680,791.85	762,523.77	764,035.26	9,856,008	4,913,575	651,377.24	17,628,311.12
Nebraska.....	22,820.49	18.98	—	118,745	64,611	578.27	206,773.74
Nevada.....	210,399.29	192,989.88	81,491.85	2,303,159	231,224	45,878.18	3,065,142.20
New Hampshire.....	62,341.16	7,165.35	10,941.30	527,568	264,147	56,487.05	948,649.86
New Jersey.....	118.99	—	—	—	83	—	201.99
New Mexico.....	401,065.64	426,086.04	518,426.97	5,062,013	1,920,355	408,824.28	8,736,770.93
New York.....	4.00	—	—	—	20	—	24.00
North Carolina.....	50,361.01	86,336.41	176,466.28	392,914	751,675	192,530.92	1,650,283.62
North Dakota.....	45.75	7.00	—	—	—	—	52.75
Ohio.....	—	—	—	1,541	—	—	1,541.00
Oklahoma.....	15,358.75	65.49	2,775.17	79,623	196,588	35,700.19	330,115.60
Oregon.....	1,149,914.66	1,428,755.95	1,013,981.59	15,882,026	7,397,834	876,916.07	27,249,458.27
Pennsylvania.....	9,703.57	7,724.04	21.42	195,277	264,044	79,976.40	556,746.43
Puerto Rico.....	238.19	7.00	3,343.09	14,934	30,024	4,714.52	53,260.80
South Carolina.....	4,214.14	402.10	48,028.61	86,367	97,345	171.08	236,527.93
South Dakota.....	216,829.87	87,106.45	78,652.52	935,287	390,430	33,879.18	1,742,825.02
Tennessee.....	24,676.13	106,854.56	27,967.79	313,087	412,724	100,304.31	985,613.79
Texas.....	144.83	—	—	57,751	19,744	—	77,639.83
Utah.....	484,886.53	464,918.34	512,489.56	4,127,121	1,214,329	183,090.76	6,986,835.19
Vermont.....	1,631.54	—	—	32,065	65,546	10,778.15	110,020.69
Virginia.....	52,299.86	58,390.16	71,784.26	418,185	527,621	154,268.85	1,282,549.13
Washington.....	822,404.19	958,090.33	732,302.49	8,516,052	5,331,012	862,891.32	17,222,752.33
West Virginia.....	7,298.71	12,830.41	5,049.24	218,040	417,113	208,604.94	868,936.30
Wisconsin.....	875.70	—	—	174,435	340,152	98,416.88	613,878.58
Wyoming.....	537,694.84	468,056.34	538,468.91	5,375,692	1,773,836	102,815.87	8,796,563.96
Total.....	9,991,624.08	10,000,000.00	9,000,000.00	111,100,000	54,600,000	9,161,997.19	203,853,621.27

Includes emergency funds.

TABLE 8.—*Condition of forest-road funds on June 30, 1936*

Fund	Appropriation	Expenditures	Balance
10 percent.....	\$9,593,267.79	\$9,039,639.44	\$553,628.35
Section 8.....	10,000,000.00	10,000,000.00	-----
Federal forest road construction.....	9,000,000.00	9,000,000.00	-----
Forest highways.....	71,000,000.00	70,802,645.37	197,354.63
Forest highways emergency construction.....	7,000,000.00	5,985,553.85	1,014,446.15
Emergency forest highways.....	8,000,000.00	7,997,245.18	(1)
Forest highways N. R. A.....	14,600,000.00	14,282,921.51	317,078.49
Forest road development.....	38,500,000.00	37,100,115.08	1,399,884.92
Forest road development emergency construction.....	3,000,000.00	2,898,379.11	101,620.89
Forest road development N. R. A.....	10,100,000.00	10,088,602.70	11,397.30
Improvement ²	9,161,997.19	9,161,997.19	-----
Total.....	189,955,264.98	186,357,099.43	3,598,410.72

¹ \$2,754.82 returned to Treasury.² Includes emergency funds.

From camps located on the national forests the Civilian Conservation Corps constructed 4,608 miles of truck trails and 716 miles of trails, and maintained 28,920 miles of the former and 14,142 of the latter. This helped considerably toward completing the planned road and trail system of the national forests and maintaining the truck trails and trails on a more satisfactory standard.

Work has been started on the selection of an economical road surface for dirt roads with a view to the elimination of dust and consequent loss of surface material on heavily traveled roads used largely for recreation. A few miles of roadway with surface treated with an admixture of calcium chloride and salt were constructed as a trial.

RANGE IMPROVEMENTS

To secure the fullest proper utilization of forage resources and to facilitate the management of the grazing of the millions of head of livestock on the national-forest ranges, a great variety of physical improvements are required. Construction is being constantly carried on to create such facilities as are necessary to the movement, control, and watering of cattle, horses, sheep, goats, and swine. Table 9 shows the construction for the fiscal year.

TABLE 9.—*Number and cost of range improvements constructed during the fiscal year 1936*

Type	Con-struct-ed	Cost	Type	Con-struct-ed	Cost
Range fences.....miles.....	1,979	\$743,053	Water development.....number.....	2,260	\$782,700
Stock driveways.....do.....	594	58,145	Miscellaneous.....	-----	136,100
Corrals.....number.....	70	22,233	Total.....	-----	1,763,540
Stock bridges.....do.....	8	21,303			

DAMS FOR WATER STORAGE

To provide lakes for recreation, fish, wildlife, and water conservation, the Forest Service constructs a large number of small dams. These dams range from less than 10 feet to 65 feet in height. They are built under competent engineering supervision and follow approved construction methods. During the year 1,017 such dams, having a total storage capacity of approximately 7,500 acre-feet, were constructed, bringing the total number to 1,980.

EROSION CONTROL

To check the evil effects of soil erosion resulting from natural processes and misuse of land the Forest Service has extended remedial work to most national-forest regions. This engineering work includes stream and gully damming and the planting of various kinds of soil-binding vegetation. To June 30, 1936, 345,424 acres of eroded land had been protected by small check dams, diversion ditches, and other minor structures; of this area 17,847 acres were

so protected during the year. To June 30, 1936, 21,193 acres of eroded land had been protected by planting to some form of vegetation; of this area 5,471 acres were so protected during the year.

SURVEYS AND MAPS

Accurate maps are necessary for most of the numerous Forest Service activities. The administrative map, published on a scale of one-fourth inch to the mile, is the most widely used. One of these maps has been prepared for each of the national forests. For the majority of them, maps have also been prepared on a scale of one-half inch to the mile, and for a few on a scale of 1 inch. Cultural features, land subdivisions, State and county lines, national-forest boundaries, and drainage, important peaks, and lookout points are shown; and contours are shown on the 1-inch scale maps and on many of the one-half inch. These maps serve as bases for planning forest activities and compiling various kinds of information, such as road, trail, and telephone systems; fire-protection data; timber types; and grazing types.

In addition, recreation folders and many maps required for special purposes are prepared. For a large number of the western forests relief models have been constructed. These are particularly valuable in visibility studies for fire detection.

The surveying and mapping conforms to the standards of accuracy prescribed by the Federal Board of Surveys and Maps. In compiling the maps the available data of other Government agencies are used. Where adequate data are not available and cannot be supplied within a reasonable time by the regular mapping agencies of the Government, the necessary surveys are made by the Forest Service. Aerial photographs are being used extensively. They are valuable also for determining fuel and forest types in fire-control studies, for range investigations, and for studying slopes in erosion control; and they are used by lookouts, rangers, and others to aid in locating reported fires and to determine the cover type and topographic conditions where a fire is reported. All flying has been done under contract with private concerns. In some cases the cameras and photographers belong to the Forest Service.

Administrative maps are lithographed or printed by either the Geological Survey, the Army Reproduction Plant, or a private firm through contract.

The aerial mapping done during the year covered 15,365 square miles and the topographic mapping 1,518 square miles. There was run 279 miles of third-order levels, and 212 third-order triangulation stations were established. Thirty-nine of the 1/4-inch, 65 of the 1/2-inch, and 5 of the 1-inch administrative maps were published, together with 6 regional maps of various scales.

TIMBER MANAGEMENT

During the year the demand for lumber improved. Prices, though not high, were firm, and lumber production stepped up all over the country. Both the receipts and the quantity of timber cut from the national forests showed a sharp increase. The receipts rose about \$472,000. The cut under timber sales and land exchanges was 1,021,156,000 board feet, as against 752,368,000 board feet in 1935—a rise of nearly 36 percent. No large sales were made to supply new milling capacity. The increase in the cut is largely the result of purchasers' stepping up their production as the price and demand for lumber return toward normal. The upward trend in cut and receipts began in the last quarter of the fiscal year 1933, and has been continuous since.

The authority carried by the act of April 17, 1935, to receive applications seeking terminations of sales contracts without the assessment of certain types of damages expired April 17, 1936. The legislation made it possible to allow operators who had bought national-forest stumpage before the depression and on the basis of the prevailing market prices for lumber at that time to withdraw from their contracts without being held liable for damages for not carrying the contracts through. Insistence upon the completion of these agreements would have resulted in many bankruptcies and the closing down of operations, with an increase of unemployment. Down to its expiration the act continued to afford purchasers opportunity to escape being forced to the wall through former commitments beyond their power to fulfill.

While sustained yield is not a panacea for all the ills of the lumber industry, without it permanency of operation and employment is impossible. Many operators have pushed liquidation so far that they now lack timber enough to put

themselves on a sustained-yield operating basis. Realizing that they are reaching the end of their own supplies, they frequently wish to prolong their operation by piecing out with purchases of national-forest timber. It is the present policy of the Forest Service not to sell national-forest timber when to do so merely aids in liquidation under a "cut-and-get-out" policy. In general, sales will be for sustained-yield management, either where the national-forest unit will furnish the entire needed wood supply or where the timber sold will be correlated with that of the private operator.

Another year of stand improvement, made possible through the continued use of the Civilian Conservation Corps, has put many additional thousands of acres in proper condition for increased growth of the more valuable tree species. The experience gained by 3 years of this type of work has made it possible to analyze carefully the different silvicultural treatments given and to reach conclusions as to the methods which are giving the best returns. The two most commonly encountered forest situations in which stand-improvement work is unquestionably profitable are new stands that are just becoming established following cutting and stands of old, defective trees of inferior species that are retarding the development of valuable understories. In the first case the objective is to favor the more-valuable and better-formed species over faster-growing weed species. This is probably the most valuable cultural operation which can be performed, since the future forest is in the making, and its composition can be largely controlled. In the second case, the inferior trees in the overstory must be felled or girdled to free the established new growth from root and crown competition and mechanical injury. Work of both these types will result in shorter rotations and in increased yields per acre, and so is an important initial step in placing forests grown under wildwood or unmanaged conditions in shape for sustained-yield management.

In the fiscal year 1936 sales of miscellaneous products, such as Christmas trees, wild shrubs, turpentine, tanbark, bow staves, and walnut burls, were fewer than in 1935, totaling \$63; but there was a marked increase in the number both of small timber sales (transactions involving \$500 or less) and of large sales (transactions involving more than \$500), totaling 18,211 and 178, respectively. For all three classes of sales the total was 19,252, as against 18,832 in 1935. The demand for fuel, fencing, and building material from the national forests continues to grow, and each year sees people coming from greater distances for their domestic wood supplies. Cultural work performed by the Civilian Conservation Corps has made large amounts of wood available, much of which does not have a commercial value and simply goes to waste in the forest if not disposed of.

The national-forest timber-sale business for the fiscal year is summarized in tables 10 and 11.

TABLE 10.—Quantity and value of national-forest timber cut under sales, fiscal year 1936

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alaska.....	38,950,000		38,950,000	57,308		57,308
Arizona.....	91,441,000	501,000	91,942,000	215,585	513	216,098
Arkansas.....	33,001,000	418,000	33,419,000	320,479	418	320,897
California.....	94,652,000	1,617,000	96,269,000	190,348	1,157	191,505
Colorado.....	47,200,000	584,000	47,784,000	110,152	553	110,705
Florida.....	11,935,000		11,935,000	62,003		62,003
Georgia.....	2,809,000		2,809,000	10,988		10,988
Idaho.....	83,420,000	4,062,000	87,482,000	259,723	3,948	263,671
Kentucky.....	226,000		226,000	980		980
Louisiana.....	463,000	4,000	467,000	965	4	969
Maine.....	326,000		326,000	890		890
Michigan.....	2,932,000	5,000	2,937,000	5,607	2	5,609
Minnesota.....	9,678,000		9,678,000	16,856		16,856
Mississippi.....	4,903,000		4,903,000	3,319		3,319
Missouri.....	315,000		315,000	918		918
Montana.....	32,919,000	3,993,000	36,912,000	76,596	4,600	81,196
Nebraska.....	56,000		56,000	108		108
Nevada.....	609,000	198,000	807,000	827	150	977
New Hampshire.....	9,355,000		9,355,000	29,793		29,793

TABLE 10.—Quantity and value of national-forest timber cut under sales, fiscal year 1936—Continued

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
New Mexico.....	12, 225, 000	853, 000	13, 078, 000	24, 699	928	25, 627
North Carolina.....	19, 610, 000		19, 610, 000	26, 490		26, 490
Oregon.....	67, 408, 000	4, 066, 000	71, 474, 000	143, 303	2, 791	146, 094
Pennsylvania.....	3, 853, 000		3, 853, 000	14, 453		14, 453
South Carolina.....	548, 000		548, 000	1, 860		1, 860
South Dakota.....	24, 825, 000	400, 000	25, 225, 000	78, 760	397	79, 157
Tennessee.....	6, 181, 000		6, 181, 000	15, 081		15, 081
Utah.....	12, 031, 000	1, 625, 000	13, 656, 000	26, 009	1, 654	27, 663
Vermont.....	1, 079, 000		1, 079, 000	5, 109		5, 109
Virginia.....	12, 280, 000		12, 280, 000	14, 550		14, 550
Washington.....	126, 696, 000	167, 000	126, 863, 000	291, 665	145	291, 810
West Virginia.....	1, 681, 000		1, 681, 000	4, 035		4, 035
Wisconsin.....	2, 945, 000		2, 945, 000	4, 026		4, 026
Wyoming.....	38, 301, 000	1, 439, 000	39, 740, 000	87, 011	1, 391	88, 402
Total, 1936.....	794, 853, 000	19, 932, 000	814, 785, 000	2, 100, 496	18, 651	¹ 2, 119, 147
Total, 1935.....	648, 840, 000	19, 406, 000	668, 246, 000	1, 700, 695	17, 943	¹ 1, 718, 638

¹ In addition, minor products not convertible into board feet were cut, the value of which was \$30,226 in 1936 and \$41,140 in 1935.

TABLE 11.—Quantity and value of national-forest timber sold, fiscal year 1936

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alaska.....	19, 170, 000		19, 170, 000	30, 163		30, 163
Arizona.....	122, 951, 000	433, 000	123, 384, 000	259, 101	450	259, 551
Arkansas.....	14, 505, 000	232, 000	14, 737, 000	249, 003	232	249, 235
California.....	183, 733, 000	1, 682, 000	185, 415, 000	330, 785	1, 275	332, 060
Colorado.....	147, 535, 000	650, 000	148, 185, 000	394, 989	634	395, 623
Florida.....	22, 098, 000		22, 098, 000	125, 622		125, 622
Georgia.....	2, 347, 000		2, 347, 000	11, 140		11, 140
Idaho.....	67, 677, 000	4, 785, 000	72, 462, 000	194, 729	4, 392	199, 121
Kentucky.....	454, 000		454, 000	1, 196		1, 196
Louisiana.....	646, 000	4, 000	650, 000	1, 103	4	1, 107
Maine.....	313, 000		313, 000	889		889
Michigan.....	10, 781, 000	5, 000	10, 786, 000	19, 177	2	19, 179
Minnesota.....	7, 259, 000		7, 259, 000	19, 080		19, 080
Mississippi.....	3, 076, 000		3, 076, 000	2, 546		2, 546
Missouri.....	315, 000		315, 000	918		918
Montana.....	38, 224, 000	3, 641, 000	41, 865, 000	96, 744	3, 600	100, 344
Nebraska.....	56, 000		56, 000	108		108
Nevada.....	746, 000	199, 000	945, 000	933	173	1, 106
New Hampshire.....	11, 859, 000		11, 859, 000	39, 431		39, 431
New Mexico.....	55, 001, 000	979, 000	55, 980, 000	115, 318	1, 035	116, 353
North Carolina.....	26, 311, 000		26, 311, 000	31, 753		31, 753
Oregon.....	64, 398, 000	3, 868, 000	68, 266, 000	127, 206	2, 683	129, 889
Pennsylvania.....	2, 638, 000		2, 638, 000	7, 340		7, 340
South Carolina.....	542, 000		542, 000	1, 790		1, 790
South Dakota.....	11, 977, 000	504, 000	12, 481, 000	30, 343	509	30, 852
Tennessee.....	5, 230, 000		5, 230, 000	12, 294		12, 294
Utah.....	7, 700, 000	1, 837, 000	9, 537, 000	17, 012	1, 877	18, 889
Vermont.....	3, 995, 000		3, 995, 000	24, 666		24, 666
Virginia.....	14, 317, 000		14, 317, 000	14, 880		14, 880
Washington.....	80, 586, 000	196, 000	80, 782, 000	132, 235	172	132, 407
West Virginia.....	2, 460, 000		2, 460, 000	7, 175		7, 175
Wisconsin.....	3, 298, 000		3, 298, 000	4, 201		4, 201
Wyoming.....	35, 630, 000	1, 461, 000	37, 091, 000	61, 128	1, 437	62, 565
Total, 1936.....	967, 828, 000	20, 476, 000	988, 304, 000	2, 364, 998	18, 475	¹ 2, 383, 473
Total, 1935.....	650, 924, 000	18, 764, 000	669, 688, 000	1, 537, 112	16, 806	¹ 1, 553, 918

¹ In addition, minor products not convertible into board feet were sold, valued at \$13,802 in 1936 and at \$21,758 in 1935.

PLANTING

The expansion in Forest Service nurseries made in 1933 and 1934 began to yield commensurate results in the calendar year 1935, when the availability of the proper species and classes of growing stock permitted the planting of 134,866 acres. In addition, 5,858 acres were sown to forest-tree seeds, bringing the total area reforested during the year to 140,724 acres—an increase of 66,008 acres over 1934. The major portion of this accomplishment was made possible by the availability of labor from the Civilian Conservation Corps camps and by allotments from the Emergency Relief appropriations.

The greatest reforestation effort at present is being put forth in the Lake States and in the South, where the national-forest areas are close to centers of population and where markets and easy accessibility permit early utilization of the wood products grown. The need for planting these areas (acquired under the Weeks law and the Clarke-McNary Act) resulted from heavy cutting, or fire, or both, prior to acquisition by the Government. In its present condition the land is nonproductive, and often it lacks adequate cover to function properly in controlling run-off on important watersheds. If it is to afford a source of raw material to support and stabilize local communities dependent on woodworking industries, it must be reforested at an early date with the proper kinds of forest trees. In the Lake States much of the land is now occupied by weed-tree species and must be underplanted, or it affords sites where the competition from rank growth of annual vegetation is particularly severe. For this reason it has been found necessary to develop more sturdy stock, requiring longer growing periods in the nursery and a greater area for transplanting.

The present appropriation of regular funds for forest planting under the authorization given in the Knutson-Vandenberg Act is limited to \$400,000. With a dropping off of emergency funds it will be necessary to obtain a much larger appropriation of regular funds if the Forest Service is to make an appreciable showing in reforesting the present 4,000,000 acres of nonproductive national-forest land suitable for the growing of forest trees. To carry on a comprehensive program of reforestation the production of the necessary growing stock must be planned for 3 or 4 years in advance of the actual planting. This can only be accomplished through permanent financing on an adequate scale.

The area planted and sown on the national forests during the calendar year 1935 is shown by States in table 12.

Table 13 shows the production capacity of the national-forest nurseries. While these nurseries are designed primarily for the production of stock to be planted on the national forests, small amounts of coniferous stock from them will be used in connection with State cooperation under the Clarke-McNary law.

In addition to the nurseries listed in table 13, there are several small or temporary nurseries in which stock is grown for experimental or small-scale planting.

TABLE 12.—*Planting and sowing on national forests, by States, calendar year 1935*

State	Area planted	Area sown	Total	State	Area planted	Area sown	Total
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>		<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Arkansas.....	953	-----	953	North Carolina.....	33	-----	33
California.....	551	87	638	Oregon.....	1,504	-----	1,504
Colorado.....	2,603	-----	2,603	Pennsylvania.....	1,975	-----	1,975
Georgia.....	32	-----	32	Puerto Rico.....	130	43	173
Idaho.....	4,913	-----	4,913	South Dakota.....	442	-----	442
Illinois.....	200	2,070	2,270	Tennessee.....	609	14	623
Louisiana.....	4,699	-----	4,699	Vermont.....	86	-----	86
Michigan.....	71,847	-----	71,847	Virginia.....	202	-----	202
Minnesota.....	8,505	-----	8,505	Washington.....	1,273	-----	1,273
Mississippi.....	5,348	-----	5,348	West Virginia.....	1,432	-----	1,432
Missouri.....	17	3,597	3,614	Wisconsin.....	24,535	47	24,582
Montana.....	1,030	-----	1,030	Wyoming.....	400	-----	400
Nebraska.....	1,136	-----	1,136				
New Hampshire.....	411	-----	411	Total.....	134,866	5,858	140,724

TABLE 13.—*Production capacity of the national-forest nurseries*

Location	Nursery	Area	Production capacity (trees)
		<i>Acres</i>	
Parsons, W. Va.....	Parsons.....	13.0	5,000,000
Alexandria, La.....	Stuart.....	112.0	50,000,000
Russellville, Ark.....	Ozark.....	15.0	5,000,000
Brooklyn, Miss.....	De Soto.....	84.0	56,000,000
Chillicothe, Ohio.....	Chillicothe.....	75.0	10,000,000
Licking, Mo.....	Licking.....	26.0	12,000,000
East Tawas, Mich.....	Beal.....	19.0	14,000,000
Manistee, Mich.....	Chittenden.....	80.0	35,000,000
Manistique, Mich.....	Manistique.....	84.0	25,000,000
Watersmeet, Mich.....	Watersmeet.....	83.0	25,000,000
Rhineland, Wis.....	Rhineland.....	56.0	25,000,000
Park Falls, Wis.....	Butternut.....	15.0	15,000,000
Hayward, Wis.....	Hayward.....	30.0	20,000,000
Cass Lake, Minn.....	Cass Lake.....	20.0	} 37,000,000
Do.....	Lydick.....	60.0	
Eveleth, Minn.....	Eveleth.....	15.0	15,000,000
Two Harbors, Minn.....	Knife River.....	40.0	15,000,000
Halsey, Nebr.....	Bessey.....	29.0	13,000,000
Monument, Colo.....	Monument.....	17.0	2,500,000
Haugen, Mont.....	Savenac.....	26.0	10,000,000
Stabler, Wash.....	Wind River.....	13.0	3,000,000
Susanville, Calif.....	Susanville.....	8.0	1,000,000
Total.....		920.0	383,500,000

¹ Part of this output is grown for the State of Nebraska at the expense of that State, and in 1935 and 1936 part was shipped for use on the shelter-belt project.

² Part of this output is grown for the State of Colorado, and at the expense of that State.

RANGE MANAGEMENT

Weather and forage conditions usually vary greatly over the wide area covered by the western national forests, and local differences also may be pronounced. The following statements portray the situation by national-forest regions. The actual stocking and management problems, however, encountered in applying the accepted principles of range and livestock administration are far more local in character and have to be worked out in accordance with specific conditions.

In region 1 (Montana and northern Idaho) drought prevailed throughout 1935. On a number of the forests a moisture deficiency has been accumulated for 7 years; water tables have been lowered and range of pests, such as grasshoppers, Mormon crickets, and rodents increased. Nevertheless, the forests west of the Continental Divide provided fair feed—60 to 70 percent of normal. By June 1936 severe drought developed on several eastern-slope forests, extending through the Dakotas. It was extremely severe on the Custer National Forest, in southeastern Montana, where up to July grass had not started. However, the more favorable cattle markets in 1935 placed the livestock operators in region 1 in a better financial condition for that year, on the whole, than for several previous years.

In region 2 (Colorado, western Nebraska, southwestern South Dakota, and that part of Wyoming east of the Continental Divide) snowfall was deficient in the winter of 1934-35. In Colorado, May 1935, however, was the wettest month in 48 years, with flood damage in the foothills and plains estimated at from \$8,000,000 to \$10,000,000. Forage growth and hay crops were good. On the other hand, on the Shoshone and Bighorn National Forests in Wyoming there was actual drought. With at least 4 years of previous subnormal precipitation, forage volume and hay yields in that neighborhood were much reduced. Six national forests in region 2 had Mormon cricket infestations; they were especially heavy on the Bighorn National Forest and on 118,000 acres of adjacent lands. The 1935 Colorado lamb crop, because of the late spring, was about 19 percent under that of 1934. For the region as a whole stock entered the forests in only fair condition in 1935, but left fat. Wool prices were lower by about 16 percent, but markets for all classes of cattle were much improved.

By June 1936 drought was assuming serious proportions in Wyoming.

In region 3 (Arizona and New Mexico) spring- and summer-feed conditions in 1935 were the best in a number of years; the winter ranges in the winter of

1935-36 were in good condition, and both cattle and sheep came through well; and 1936 spring conditions were again favorable. The Government purchase program of 1934 helped to point up herds. Better market conditions in 1935 permitted good liquidation on indebtedness.

In region 4 (Utah, southern Idaho, western Wyoming, and most of Nevada) the outlook was discouraging in April and into May 1935, when unusually heavy precipitation occurred. Although no further rainfall of consequence followed until well into September, growing conditions averaged 92 percent of normal, as against 62 percent in 1934, and the forage volume was from 35 to 45 percent greater than in 1934. Stock left the national forests in as good condition as in recent years or better, with lambs from 3 to 5 pounds heavier. Those that were held over wintered well, and to the end of June the outlook for 1936 was very encouraging. The favorable 1935 cattle market permitted payments on obligations, and there was general optimism among cattle producers.

In region 5 (California and western Nevada) the precipitation in the winter and spring of 1934-35 averaged about 76 percent of normal. Grass and weeds started early on the foothills and lower lands in California, a large amount of feed was available shortly after the first fall rains, and growth continued throughout the winter. On the high ranges, in the spring of 1935 growth was delayed a month or 6 weeks. For 1936 the outlook was poor in southern California and good in northern California. The distinct improvement in markets the first 6 months of 1935 dropped somewhat the latter half of the year, but the general condition of the industry was much improved, and cattlemen especially were optimistic.

In region 6 (Oregon and Washington) concern in the fall of 1935, due to a deficiency of precipitation, was dispelled after January 1, 1936, by a tremendous abundance. Some lakes, dry for years, began filling up. Early in March the prospects for a summer of adequate moisture, with good ground-water supplies, were excellent; but previous deficiency accumulations made advisable conservative stocking of the ranges. There were ample feed supplies from the previous year, and there was some carry-over of hay. The generally improved cattle market of 1935 was reflected in more interest by local credit agencies.

It has been strikingly evidenced throughout the western national-forest ranges that, where stocking is such as to permit a substantial part of the season's growth to remain, new growth the following year is more vigorous and in drought years, adequate to meet the emergency. On critical national-forest areas this year, where such a stocking had obtained, permittees will manage to carry their stock well into the fall. Where it had not, the removal of part or all of the stock will be necessary for lack of feed. Drought experiences with the national-forest pastures are pointing increasingly to the necessity of leaving an average of at least 30 percent of the feed unutilized in normal seasons to secure the best new growth the following season. The distressing drought experiences of the last few years are emphasizing the need to conserve pastures and ranges if the economic and social security of the range country is to be preserved.

RANGE USE

In the calendar year 1935 the number of cattle permittees increased 1 percent, and the number of sheep permittees 1.7 percent, but the number of cattle allowed to graze under permit decreased 5 percent, and of sheep 8 percent. Table 14 shows the numbers, by States. In addition to the stock under permits, there were grazed in the six western national-forest regions 57,510 cattle and horses and 9,703 sheep and goats under the regulation authorizing free-use grazing of not to exceed 10 head of stock used for domestic purposes, or by prospectors, campers, and travelers, or in connection with permitted operations on the national forests.

A liberal nonuse policy was continued. It allows, when the circumstances justify, temporary, partial, or entire disuse of range by permittees having established preferences without impairment of their preference standing. The generally more favorable forage and market conditions and the smaller percentages of increases in both calves and lambs resulted in more than normal marketings of breeding stock to reduce or liquidate livestock loans. The volume of nonuse by regular permittees totaled 61,778 cattle and horses and 185,519 sheep and goats. The numbers for 1934 were 56,820 cattle and horses and 329,953 sheep and goats.

TABLE 14.—Grazing permits issued and numbers of stock allowed under pay permit on the national forests, by States, calendar year 1935

State	Cattle, horses, and swine				Sheep and goats		
	Permits issued	Stock grazed			Permits issued	Stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Arizona.....	1,037	183,683	922	55	92	252,117	-----
Arkansas.....	20	562	-----	57	-----	-----	-----
California.....	1,564	135,582	3,641	70	249	316,353	449
Colorado.....	2,844	267,330	1,974	-----	889	904,397	50
Florida.....	16	550	-----	-----	-----	-----	-----
Georgia.....	70	260	-----	8	4	41	-----
Idaho.....	3,016	129,165	4,838	-----	1,151	1,229,721	-----
Kentucky.....	-----	-----	-----	-----	-----	-----	-----
Missouri.....	1	10	-----	-----	-----	-----	-----
Montana.....	1,856	113,422	5,767	-----	388	532,094	-----
Nebraska.....	37	12,048	268	-----	-----	-----	-----
Nevada.....	319	54,115	1,628	-----	135	282,586	-----
New Hampshire.....	3	35	-----	-----	-----	-----	-----
New Mexico.....	2,171	89,174	1,755	15	266	179,410	8,639
North Carolina.....	112	626	1	87	13	135	-----
Oregon.....	1,120	81,548	1,155	-----	404	562,756	-----
Pennsylvania.....	2	29	-----	-----	-----	-----	-----
South Carolina.....	23	77	2	-----	-----	-----	10
South Dakota.....	628	25,040	859	-----	46	23,384	-----
Tennessee.....	26	173	-----	-----	-----	-----	-----
Utah.....	4,166	103,313	2,968	-----	1,861	680,971	-----
Virginia.....	42	389	-----	-----	1	25	-----
Washington.....	436	15,507	353	-----	92	135,139	-----
West Virginia.....	49	517	13	-----	82	2,144	-----
Wisconsin.....	25	440	-----	-----	-----	-----	-----
Wyoming.....	882	101,638	2,941	-----	336	580,665	-----
Total, 1935.....	20,465	1,315,233	29,085	292	6,009	5,681,938	9,148
Total, 1934.....	20,250	1,389,387	29,549	314	5,911	6,152,244	9,124

Permit reductions were chiefly for range protection and were necessitated by reduced carrying capacity and resultant overstocking due to the cumulative effects of the drought period. Reductions purely for protection and range betterment have been generally accepted with a minimum of protest. In some cases reductions have been made voluntarily. While many permittees took advantage of the good 1935 markets to reduce their stock, the demand for range on nearly all the national forests continues far in excess of the range capacity. The demands are intensified by growing limitations on other grazing lands. The reductions in 1935 for protection amounted to 37,210 cattle and horses and 238,885 sheep and goats (equivalent to 2.5 and 3.8 percent, respectively, of the total numbers allowed in 1934); and for distribution, 15,500 cattle and horses and 100,423 sheep and goats. Reductions for distribution varied regionally and were largest in total in the intermountain and the southwestern regions (regions 4 and 3).

Where reductions were necessary, they were applied first to stock covered by temporary permits. In 1935, 18 percent of the cattle and 14 percent of the sheep were so covered, as against 20 and 16 percent, respectively, in 1934. In lieu of reducing numbers, in some cases the range load was lightened by shorter seasons of use corresponding more nearly to the cycle of plant growth. The trend in actual use of the ranges for the 10-year period 1926-35 is shown by animal-months in table 15. The usable national-forest area in 1935 was 767,332 acres less than in 1934.

TERM PERMITS

The 10-year permits authorized by the 1925 grazing regulations expired in 1934. No term permits were issued in 1935. New conditions were demanding more flexibility in grazing administration, and many other considerations, such as the effects of drought and the demand for a wider distribution of grazing privileges, entered into the decision. Many of the smaller permittees have preferred annual permits because of their greater flexibility, even though their holders are subject to larger reductions if necessary for range protection. In 1934 51 percent of the cattle and 39 percent of the sheep were grazed under annual or temporary permits.

TABLE 15.—Range use of the western national forests, 1926–35

Year	Animal-months		Total reduced to cow-months	Year	Animal-months		Total reduced to cow-months
	Cattle and horses	Sheep and goats			Cattle and horses	Sheep and goats	
1926	9, 521, 253	20, 666, 133	13, 654, 480	1933	8, 436, 968	18, 987, 131	12, 234, 394
1927	9, 039, 596	20, 209, 935	13, 081, 583	1934	8, 558, 651	20, 141, 495	12, 586, 950
1928	8, 407, 668	21, 230, 434	12, 643, 755	1935	7, 515, 146	17, 628, 988	11, 040, 934
1929	7, 979, 431	20, 744, 076	12, 128, 246				
1930	8, 417, 461	21, 259, 351	12, 669, 331	Changes from—	Percent	Percent	Percent
1931	8, 458, 526	21, 139, 250	12, 686, 376	1926 to 1934	—10	—3	—8
1932	8, 382, 705	19, 457, 501	12, 274, 205	1926 to 1935	—21	—15	—19

After full consideration and conferences with representatives of the general livestock and range industry, the Secretary of Agriculture on February 19, 1936, approved a policy reaffirming the principle of term permits as a stabilization measure and providing for the issuance of term permits for the period 1936 to 1945, inclusive, within the established maximum limits for any given national forest and within the ranch-property commensurateness of established permittees.

The following policy was adopted to govern reductions in the numbers of stock grazing under a term permit:

1. Reductions for distribution, including that made in 1935, will not exceed 20 percent for the 10-year period 1936–45.

2. In any one year, no greater reduction than 5 percent will be made for distribution.

3. At the expiration of the year 1940, such reductions can be made for protection as the circumstances justify.

4. Protection and distribution reductions will be worked out separately.

5. All term permits will carry clauses determined by local conditions, specifying the maximum reductions which may be made for distribution during the entire period 1936–45.

6. Reductions for all purposes during the period 1936–40, inclusive, will not exceed 30 percent, including the reductions made in 1935; nor will they exceed 15 percent in any one year.

7. Adjustments to be made under this program will first be taken up with the local stockmen, and full consideration given their views.

DISTRIBUTION SURVEY

The report for 1935 stated that "a further study of the distribution of range privileges is of paramount importance." Such a study presents many phases. It must take cognizance of many conflicting farm, range, and other interests. It involves a thorough analysis of the relationships between the use of national-forest grazing resources and regional or local economic and social problems. The administration of grazing on the public domain and the use of private lands directly or indirectly for livestock purposes also constitute important parts of the general picture.

To obtain the necessary information regarding the farming and grazing situation, representative localities were selected for study throughout the national-forest regions. It is expected to complete this study by 1937. It deals particularly with the correlation between the use of agricultural lands and the use of national-forest ranges; the extent to which restrictions on grazing will be necessary to provide for wildlife, timber production, and the use of other natural resources in the locality; and the proper allocation of the use of national-forest ranges in connection with the grazing use of private, State, and other Federal lands. The Bureau of Agricultural Economics is cooperating in the study, and assistance in special situations is being extended by the Agricultural Adjustment Administration and by certain of the State colleges.

The 1930 census reports showed 503,047 farms in the 11 Western States. This was more than double the 1900 number. Agriculture in the Western States showed a rapid rise during the period 1900–20; a slower growth between 1920 and 1925; and very little increase from 1925 to 1930. Farms within the

national-forest and dependency zones in 1934 totaled 97,060, of which 22,337 were classed as grazing, 2,918 as ranch headquarters, and 71,805 as crop-production units with their crops largely related to livestock uses. At present the national-forest ranges are used in connection with about 4.5 million acres of crop-producing lands and 22 million acres of grazing lands privately owned by approximately 26,500 permittees. While only 13 percent of all the cattle and 23 percent of the sheep owned in the 11 Western States are grazed on the national forests, the relative importance of these public ranges, especially to dependent lands, is much greater than the figures would indicate. Some States show a larger proportion of use and dependency than others. A large portion of the national-forest range produces choice summer forage of special value for developing lambs and fattening beef cattle. To those dependent for their living upon use of this kind of range it is like water to parched fields. The social and economic life of many thousands of individuals and hundreds of western communities is thus dependent upon the pasture resources of the national forests.

ADVISORY BOARDS

Almost from the initiation of grazing regulation, local livestock associations have been fostered, and their cooperation through the medium of advisory boards has been encouraged. There were 740 associations in 1935, of which 692 met the advisory-board requirements. The primary purpose of the grazing regulations is to make the national forests as useful to the people dependent upon them as is possible consistently with the protection and perpetuation of the grazing resource. The advisory boards afford the holders of grazing permits an opportunity to share in the administration of grazing and in working out measures to facilitate the application of progressive principles in range use. The fact that 93½ percent of the national-forest livestock associations have qualified for this recognition shows the interest of the permittees and the importance of continuing this form of cooperation. Annual or special meetings of the local livestock association or its advisory board, attended by the local forest officer to discuss and agree upon current plans and management, have come to be matters of regular procedure.

The regional foresters and their representatives are endeavoring also to maintain contacts and advisory relations with National and State livestock organizations, which deal with many important matters relating to the general livestock and range industry.

TRESPASSING STOCK

Good progress was made in better control of trespass. Where situations are difficult, more boundary fences are called for. Cattle trespasses dropped 28 percent and sheep trespasses 22 percent below the number in the calendar year 1934, when conditions were made difficult by range shortage and financial troubles. Wild horses were reduced 12 percent, with some 6,500 in trespass in 1935. Twenty-six total or partial revocations of cattle and horse permits and 10 of sheep and goat permits were made for cause, involving 1,140 cattle and horses and 14,610 sheep and goats, as against 23 cattle and horse permits for 867 head and 10 sheep and goat permits for 5,562 head in 1934.

LIVESTOCK LOSSES

Table 16 shows the livestock losses in 1935 and 1934. Cattle losses from larkspur poisoning usually increase in wet years. In the Rocky Mountain region they were 31 percent greater in 1935 than in 1934, but in the California region they were decidedly lower as a result of the eradication work done on critical areas in 1934. There was some reduction in sheep and lamb losses from predatory animals, but outside the forests in the Rocky Mountain region stockmen reported increased losses. Predators continue to be the largest cause of losses in sheep and lambs.

Poisonous plants infest 1,597,849 acres and rodents infest 13,050,487 acres of the ranges. Eradication treatments for the former have covered 328,919 acres, of which 5,272 acres were covered in 1935, and for the latter 13,168,944 acres, of which 717,952 acres were covered in 1935. The Civilian Conservation Corps and public-relief programs cooperating with the Bureau of Biological Survey and the Forest Service rendered valuable aid in the rodent-control work.

TABLE 16.—*Livestock losses, 1935*

CATTLE AND HORSES

Region	From poisonous plants		From predatory animals		From disease		From other causes		Total	
	Number	Value	Number	Value	Number	Value	Number	Value	Number	Value
1.....	370	\$11,100	29	\$870	49	\$1,470	560	\$16,800	1,008	\$30,240
2.....	3,458	103,740	201	6,030	1,072	32,160	1,858	55,740	6,589	197,670
3.....	624	18,720	1,140	34,200	845	25,350	2,117	63,510	4,726	141,780
4.....	2,341	70,230	108	3,240	215	6,450	1,576	47,280	4,240	127,200
5.....	307	9,210	93	2,790	142	4,260	711	21,330	1,253	37,590
6.....	220	6,600	6	180	94	2,820	505	15,150	825	24,750
Total, 1935....	7,320	219,600	1,577	47,310	2,417	72,510	7,327	219,810	18,641	559,230
Total, 1934....	6,347	190,410	1,463	43,890	2,546	76,380	10,471	314,130	20,827	624,810

SHEEP AND GOATS

1.....	3,536	\$17,680	6,959	\$34,795	655	\$3,275	7,430	\$37,150	18,580	\$92,900
2.....	7,121	35,605	13,374	66,870	4,151	20,755	10,200	51,000	34,846	174,230
3.....	1,069	5,345	1,608	8,040	615	3,075	537	2,685	3,829	19,145
4.....	12,346	61,730	30,351	151,755	5,000	25,000	16,126	80,630	63,823	319,115
5.....	1,468	7,340	3,561	17,805	780	3,900	3,883	19,415	9,692	48,460
6.....	3,279	16,395	8,155	40,775	2,131	10,655	7,075	35,375	20,640	103,200
Total, 1935....	28,819	144,095	64,008	320,040	13,332	66,660	45,251	226,255	151,410	757,050
Total, 1934....	34,077	170,385	78,837	394,185	15,111	75,555	62,207	311,035	190,232	951,160

RANGE IMPROVEMENTS

The provision of range improvements has been greatly facilitated by the Civilian Conservation Corps and other relief appropriations. The improvements made during the fiscal year are shown on page 20. Better range-management practices are greatly facilitated by these improvements. Permittees have cooperated extensively in constructing and maintaining them, particularly during periods when their industry was prosperous.

RANGE SURVEYS AND MANAGEMENT

During the calendar year 1935, 4,108,525 acres were covered by intensive range surveys, bringing the total to more than 70,000,000 acres. In 1934, 7,832,117 acres were covered. Progress has been slowed down during the last 3 years by the large amount of emergency work on the national forests. Some regions did not man any parties for this work in 1935. Some aerial surveys have been made and are being found very efficient and economical in developing detailed culture maps for use in range and other resource management. Out of the surveys, combined with the everyday management of livestock on the ranges, are being developed progressive unit management plans in a form that permittees can interpret and apply. Plans of this type have been perfected for 3,483 out of a total of 4,286 cattle and horse allotments on the western national forests, and for 3,991 out of 4,836 sheep- and goat-range allotments. Other provisions for obtaining data in the interests of better range-resource information and management include 1,709 fenced observation plots and 2,129 unfenced; 946 fenced quadrats and 1,532 unfenced; and collections totaling 82,182 individual plant specimens filed in forest rangers', supervisors', and regional-office herbariums.

RECREATIONAL USE

Statements of the total estimated numbers of visitors to the national forests during a single season would seem to place half the people of the United States in that category. Of course, that is not the case. The estimates are inevitably swelled by the fact that in any year many people visit a number of forests or make repeated visits to the same forest. The figures are of greater value as indicators of trends of recreational use than as exact measures. They show that an increasing public of very large proportions finds in the national forests

desirable conditions for wholesome outdoor recreation. The estimated numbers of visitors during the fiscal year, by classes, were: Summer-home owners and guests, 849,785; hotel and resort guests, 1,792,364; campers, 2,458,425; picnickers, 6,790,920; visiting motorists, horsemen, hikers, etc., 11,969,905; and transient motorists en route elsewhere, 47,787,100; a grand total of 71,648,499, and an increase of 13,100,482 over the numbers during the preceding year.

This type of public use of the public forests is in all respects deserving of encouragement. The visitors need the recreational opportunity, and the dependent local communities need the money the visitors bring in. The public value of the national forests is greatly increased, and the heavy investment in road systems yields a larger return.

Three out of every four States now contain national forests readily accessible to large numbers of people. Their use for recreation is democratic and free, and involves a minimum of formality. Through normal administrative development supplemented by the Civilian Conservation Corps and employment-relief programs, the recreational values have been enhanced. Each year the improvement of old roads and the construction of new ones opens up areas previously inaccessible to most visitors. Many of these areas are rich in recreational quality and have the added attraction of novelty. The resulting increased use enlarges the task of protection and administration. In part this calls for additional supervisory personnel, but in large part it calls for the development and maintenance of adequate numbers of public campgrounds so equipped that they will draw and hold the visitors. Such campgrounds do away with the hazards to public property and health created by large numbers of persons scattered promiscuously over extensive areas of high fire risk or upon watersheds from which domestic water supplies are drawn.

National-forest campgrounds now require standards or types of development of higher quality than in earlier years, as use increases and as improved facilities elsewhere create a public demand for corresponding facilities in the national forests. Some of the relatively crude improvements installed years ago must be replaced to maintain the effectiveness of the campgrounds. The growing use of automobile trailers has necessitated considerable campground modification.

The demand is increasing for privileges of occupancy of national-forest lands by outdoor resorts, summer camps, and summer homes. The greater permanency of and larger investments in these types of improvements call for more careful planning to prevent conflicts with public use of important recreation areas or with the proper utilization of natural resources. The same need exists for careful planning of roads and industrial operations. To assure that current action does not destroy or impair national values likely to be of growing importance as time goes on, the Forest Service now has a number of technicians in landscape planning and recreational development and management.

In continuation of the policy under which appropriate portions of the national forests are designated as primitive areas, within which road construction, industrial occupancy, and other forms of development and use inconsistent with the preservation of unchanged natural conditions are not allowed, the Sycamore Canyon area of 47,230 acres was established in the Coconino Forest in Arizona, 628,200 acres were added to the North Cascade-Mount Baker area in the Chelan and Mount Baker Forests in the State of Washington, and 72,440 acres were added to the Goat Rocks area in the Snoqualmie and Columbia Forests, also in Washington. At the end of the year there were 67 primitive areas, with an aggregate area of 11,212,101 acres. They guarantee lovers of primitive nature opportunity to enjoy and study it in as nearly an unmodified form as possible.

The availability of Civilian Conservation Corps and relief labor enabled the installation of necessary facilities on 731 additional public campgrounds and improvement of the facilities of many campgrounds previously developed. The total number of improved national-forest public campgrounds is now 3,747.

WATER POWER

It is difficult to comprehend the size, importance, and value of the water resources of the national forests. With more than 10 percent of the continental United States land area within the boundaries of the national forests and approved purchase units, it can easily be realized that the water resource is great in amount and that it is a large percentage of the total in the entire

country. But it is even greater than indicated by the ratio of areas, since very largely the national forests are located in the mountainous sections and accordingly the opportunities for power development are greater and the run-off per square mile of drainage area is higher than in sections of less slope. It is generally estimated that from one-fourth to one-third of the water-power resources of the United States are within the boundaries of the national forests. Hundreds of irrigation projects and scores of large municipal water-supply systems are entirely dependent on the national forests for their water supply. The influence goes much further and extends to power, irrigation, and domestic-supply uses hundreds of miles away, to navigation, and to flood control.

The water-power work of the Forest Service falls into three classes:

1. Administration of permits and easements granted by the Department of Agriculture or Forest Service prior to passage of the Federal Water Power Act in 1920.

2. Acting as field agent for the Federal Power Commission on applications for permits and licenses affecting national-forest land. This involves the receipt, examination, and certification of applications; contacts with applicants, permittees, and licensees; engineering investigation studies and preparation of reports; determinations of power capacity; estimates of construction and operation costs and of costs of power; investigations of the kind, size, and location of possible markets; determinations of the ability of applicants to finance, and of the economic justifications for construction; supervision of operations, as to compliance with the provisions of the permits and licenses; check of design of dams for safety, and inspection of their construction; periodic and special reports; valuations, appraisals, and some cost accounting.

3. Investigation and report on conflicts between water power and other uses of national-forest land, together with recommendations for the creation, modification, or vacation of power withdrawals and classifications, or for other procedure or action directed toward utilization of the resources for the use of highest value.

Activity in water-power development showed a marked increase during the year. The Federal Power Commission received 52 applications for permits or licenses involving the use of national-forest lands. This was 23 more than in the fiscal year 1935, 29 more than in 1934, and more than in any fiscal year since 1930. Also, it was 77 percent of the total number of applications filed under the provisions of the Federal Water Power Act during 1936.

When the year closed, the Forest Service, acting for the Federal Power Commission, was supervising the operations under 386 permits and licenses. One valuation report was made. Monthly reports on investigation of applications for permits, licenses, and amendments and on construction covered 104 cases.

At the end of the year 202 permits and easements issued by the Department of Agriculture through the Forest Service prior to the enactment of the Federal Water Power Act were still in effect. Of this total, 95 were power projects with a total estimated average low-flow output of 362,124 horsepower and 107 covered transmission lines with a total length of 964.25 miles within the national-forest boundaries. An annual rental fee was involved in 49 of the power projects with an estimated low-flow output of 337,014 horsepower, and in 87 of the transmission-line cases with a length of 807.78 miles, leaving 46 power projects with an estimated average output of 25,110 horsepower and 20 transmission lines with a total length of 156.48 miles for which no rental fee was required.

WILDLIFE MANAGEMENT

The close relationships of various game animals to forage and other products of the national forests have increasingly emphasized the interrelations of the wildlife resource with economic, recreational, and other forest uses. There is need to study and work out interrelations and practical programs through cooperation and through the application of research and sound planning. There is much that is not known or understood as to food and other conflicts, or lack of them. The various subjects can best be approached through a separate division of wildlife management, the creation of which was approved on June 1, 1936. H. L. Shantz, recently president of the University of Arizona, a student and authority on wildlife subjects in their varied research and economic relations, has accepted the Washington assignment as Chief of the

Division. Field offices will have similar organizational plans as growing needs and problems may require.

Cooperation with various Federal, State, and local wildlife agencies and with interests directly dependent upon the forest resources will enter prominently into the plans and programs. Cooperative arrangements, for instance, have been perfected with the United States Bureau of Biological Survey by which that Bureau will be the recognized bureau of the Federal Government directly responsible for conducting the research necessary as a foundation for sound wildlife management. The United States Bureau of Fisheries, with which also a formal cooperative agreement has been perfected, is the recognized bureau of the Federal Government directly responsible for conducting the research necessary for fisheries' management and the development of a comprehensive scientific program for rearing and planting fish. The State departments and the research facilities of State universities and colleges will also be in a position to make large and important contributions to programs that may be agreed upon.

Public interest has greatly increased in the subject of wildlife and is asking that it be given due consideration in land and resource management. That wildlife is distinctly a product of the national forests, which have a great diversity of conditions suitable for it, is generally recognized. The extension of settlements and other uses of lands have necessarily changed the former habitats of a number of species. The wildlife-resource problem must therefore be dealt with in large part according to present habitat, environment, and possibilities. The national forests now harbor during the summer period about three-fourths of the big game ranging in the Western States. National-forest and purchase areas east of the Mississippi, while of smaller extent, are also important as the yearlong home of different species. More than 1,500,000 big-game animals and nearly that number of fur bearers are present, according to current estimates. This is a total of about 120 percent increase in big game since 1924. While the present numbers of game cannot be considered excessive on a gross national-forest area of more than 197,000,000 acres, local problems are developing as a result of concentrated increases on certain areas. Present numbers of game do not limit the possibilities of wildlife production on national-forest summer ranges. However, the encouragement of increases will have to be related to and determined by the practical possibilities of the locality which may be under consideration. About 40 percent only of big-game winter ranges, on an average, are within the national forests. With more than 60 percent outside the boundaries, winter ranges become a very definite limiting factor in possible game increases under present conditions. Objectives in numbers must be considered in relation to yearlong game requirements. Where winter ranges occur within the national forests, special consideration in the interests of wildlife are being progressively given them. Game birds also are important.

Fishing resources consist of approximately 70,000 miles of trout streams and thousands of other natural and artificial bodies of water suitable for game fish. Forest officers planted from State and Federal hatcheries during the period 1933-35 more than 401¼ million fish. There were constructed during that same period 59 lakes, with a total area of 5,303.7 acres. Stream-improvement facilities numbered 31,084. Adding to this work the more extensive similar activities of other agencies helps to portray the national scope of and interest in the fishing resource. The Forest Service is endeavoring to meet its own wildlife responsibilities on lands and waters under its supervision.

Of special importance among wildlife considerations are the relations with growing recreational uses; also domestic livestock uses. National-forest visitors, fishermen and hunters included, increase each year. Domestic stock grazed on the forests total, with their increase, more than 12,000,000 animals. Sheep use about 20 percent of the national-forest area in the Western States, and cattle 42 percent; 38 percent of the area is not used by domestic stock. It is where game and domestic stock use the same range that objectives and management plans need first attention.

The accumulation of basic data and its application to planned management will constitute one of the principal activities of the recently established Division of Wildlife Management.

Table 17 shows the estimated numbers and species of big-game animals for 1935, with a comparison of the total with those for 1934 and 1933.

TABLE 17.—*Number of big-game animals on national forests, by States, estimated as of Dec. 31, 1935*

State	Antelope	Bear		Deer	Elk	Moose	Mountain goats	Mountain sheep
		Black or brown	Grizzly					
Alabama.....				900				
Alaska.....		6, 200	14, 500	49, 800	50	565	5, 900	1, 625
Arizona.....	5, 410	775	6	80, 170	4, 810			190
Arkansas.....				4, 360	13			
California.....	2, 326	12, 074		271, 000	155			392
Colorado.....	212	3, 665	5	55, 540	15, 259			2, 750
Florida.....		86		8, 900				
Georgia.....		5		214				
Idaho.....	4, 568	5, 406	79	75, 205	13, 822	588	3, 272	1, 840
Louisiana.....				123				
Maine.....		33		215				
Michigan.....		666		109, 893	11	9		
Minnesota.....		597		84, 078		1, 184		
Mississippi.....				124				
Montana.....	850	5, 134	471	64, 476	17, 920	1, 632	3, 992	1, 782
Nebraska.....				189				
Nevada.....	220			11, 450	110			210
New Hampshire.....		336		1, 664				
New Mexico.....	1, 080	1, 320	19	99, 520	900			105
North Carolina.....		616		5, 788	9			
Oklahoma.....				500				
Oregon.....	775	4, 550		92, 240	13, 300			50
Pennsylvania.....		267		23, 164				
South Carolina.....		2		1, 265				
South Dakota.....	12			7, 475	362		18	
Texas.....				2, 447				
Tennessee.....		7		496				
Utah.....	130	546	4	87, 460	3, 865	5		150
Vermont.....		50		100				
Virginia.....		538		1, 430	50			
Washington.....		8, 460	6	42, 600	12, 705		5, 329	10
West Virginia.....		1, 278		2, 305				
Wisconsin.....		275		88, 658				
Wyoming.....	1, 015	2, 193	179	26, 580	34, 575	2, 203		3, 820
Total, 1935.....	16, 598	55, 079	5, 269	1, 291, 329	117, 916	6, 186	18, 511	12, 924
Total, 1934.....	15, 013	55, 122	5, 172	1, 038, 416	120, 638	8, 127	17, 962	13, 145
Total, 1933.....	14, 458	55, 840	5, 221	938, 332	115, 197	8, 084	20, 183	12, 150

¹ Includes Alaska brown bear.

EMERGENCY CONSERVATION WORK

Under the revised scheme of organization put into effect during the year, a group of three divisions was set up to handle the Emergency Conservation Work activities of the Forest Service. These activities relate solely to the Civilian Conservation Corps.

The Civilian Conservation Corps was at the time of its organization a new departure and experiment in American conservation. Authorized by the act of Congress of March 31, 1933, it began to function in early April 1933. Its three main purposes were the employment of idle youths, their physical, mental, and spiritual rehabilitation through healthful outdoor work, and the doing of a vast amount of much-needed forestry and other conservation work throughout the country. The annual accomplishments are set forth in detail in the successive reports of the Director of Emergency Conservation Work. The present report is concerned only with what has been accomplished in forestry, under the general supervision of the Forest Service.

Table 18 shows the average yearly number of Civilian Conservation Corps camps maintained for forestry work of the various classes.

TABLE 18.—*Average yearly number and distribution of Civilian Conservation Corps camps maintained for forestry work during the 3 years ended, respectively, Mar. 31, 1934, 1935, and 1936*

Class of work	Mar. 31, 1934	Mar. 31, 1935	Mar. 31, 1936
National forest.....	525	471	644
State forest.....	319	305	366
Private forest.....	221	171	230
Tennessee Valley Authority.....	20	21	34
Total.....	1,085	968	1,274

In the contribution made by the Civilian Conservation Corps to the advancement of forest conservation on national, State, and private forest lands, protection from fire, insects, and disease has held first place. The protection work done during the past year on the national forests is dealt with specifically elsewhere in this report. The construction of telephone lines, firebreaks, lookout towers, truck trails and bridges, emergency airplane landing fields, tool houses and tool boxes, and the removal of fire hazards are examples of one part of the work. The actual fighting of forest fires is another part. Probably the largest single contribution of the enrollees has been made in this part.

Forest-development work done by the Civilian Conservation Corps includes the selection and preparation of thousands of public campgrounds, recreation spots, recreation trails, and tourist registers and shelters; the building of dams for swimming and wading and for rearing fish; the improvement of fishing streams either by clearing out obstructions to provide cooler and swifter water or by placing bars, riffles, and floats; and the actual stocking of waters with young fish. Another important work has been the contribution of the Civilian Conservation Corps to forest planting on Federal and State lands. As is noted elsewhere, the acreage planted on the national forests last year was the greatest ever attained. Not only were many million young trees planted, but also the nurseries in which these seedlings were grown had been constructed and the forest seed from which the seedlings sprang were collected by the Civilian Conservation Corps enrollees. They were employed on a large scale in timber-stand improvement, timber surveys and mapping, and range development and improvement; they built guard and ranger cabins, warehouses, shelters, bridges, stock fences and corrals, and many other auxiliaries of forest and range administration; they constructed a multitude of small erosion dams on forest ranges, to store flood waters and to stop gullyng.

The coming of the Civilian Conservation Corps called for the employment of thousands of foresters, and the number of technically trained men available in the country was wholly inadequate to meet the demand for a qualified supervisory field personnel. Hundreds of young foresters just graduated from their professional schools unexpectedly found positions waiting for them which offered an immediate chance to gain both a living and valuable forestry experience. Likewise, through the "student enrollees", the Civilian Conservation Corps has taken on for temporary summer jobs in the camps thousands of young men who needed to earn something during their vacations as well as to gain experience in forest work. Thus the corps has been a boon to foresters, both experienced and unexperienced, during the last 3 years, and its work has been a great stimulus to the profession. It has also made a large contribution to American forestry by its stimulation of a wider public interest in forestry and conservation. The public has seen conservation and forestry work growing under its very eyes into things definite, visible, and tangible. Further, more than one and one-half million young men, from every part of the country, of whom more than three out of four were under 22 years of age, have been doing work which has brought home to them that this work was a public need. When they leave the camps and return to their communities, each one carries with him some lessons of conservation, learned by doing. Through their services in the Civilian Conservation Corps America is going to be more conservation-conscious from now on than ever before.

STATE AND PRIVATE FORESTRY

The reorganization effected during the year brought together the units concerned with State and private forestry activities. The divisions specifically involved were those handling State cooperation under the Clarke-McNary and Fulmer Acts, private forestry work, and the Plains shelterbelt project.

PROGRESS IN STATE FORESTRY LEGISLATION

Comparatively few of the State legislatures held regular sessions during the year, but there were many special or called sessions.

Kentucky, which formerly restricted Federal acquisition for national forests to lands in the mountain section, authorized purchases anywhere in the State if the Governor had approved the establishment of the national forest involved.

Mississippi provided that State receipts from national-forest revenues shall be distributed to the counties in which the forests are located and expended for roads and schools, as recommended by the county superintendent of education and approved by the board of supervisors. Minnesota authorized counties to borrow under certain conditions in anticipation of national-forest receipts. Wisconsin provided for a distribution of receipts among the counties in proportion to the national-forest acreage in each, to be used 75 percent for school aid and the remainder for the construction of highways within or leading to national forests, except that in counties receiving less than \$500 a year the entire sum is to be for school aid.

Virginia authorized the State commission of conservation and development to cooperate with the Federal Government under the terms of the Fulmer Act, and gave the commission broad authority for the administration of State forests provided the commission did not obligate the State for expenditures in excess of the donated and appropriated funds. The counties in which lands are acquired for State forests are to receive one-fourth of the gross receipts for their general funds. Wisconsin similarly authorized cooperative agreements with the Federal Government for the acquisition and development of State forests; prescribed that all receipts from State-forest lands shall be paid into the reforestation fund for the purchase and improvement of additional lands for forest or park purposes; and authorized the selling of timber and other forest products from State lands, the income to go into the reforestation fund. Rhode Island authorized the division of forests, parks, and parkways to acquire for public use lands within the so-called "option area" (or areas) of the State. Option areas comprise lands deemed by designated State officials to be submarginal or necessary for forestry, erosion control, flood control, wildlife management and preservation, and recreation purposes.

Ohio authorized the board of control of the agricultural experiment station to acquire or lease property for development as State forests, building sites, and State parks. Alabama appropriated \$25,000 annually for the quadrennium beginning October 1, 1935, for land acquisition for State forests and parks. Minnesota added to the area of the Beltrami Island State Forest, but reduced the area of the White Earth State Forest.

Kentucky, under a law reorganizing the departments of the State government, transferred all the powers and duties of the State forester to a department of conservation, headed by a commissioner and made up of five divisions. The division of forestry is under a director appointed by the commissioner of conservation with the approval of the Governor. The director must have had at least 4 years of experience in forestry work, or an equivalent experience. Mississippi authorized the creation of a State board of park supervisors, composed of three members of the State forestry commission to be designated by the Governor, and given broad power and authority for the purpose of advancing the recreation and conservation interests in State parks.

State forest-fire legislation was added to in a few instances. Kentucky provided fine or imprisonment, or both, for starting and failing or refusing to extinguish fire within any forest reserve or park or other woodland within the confines of the Commonwealth over which it or the Federal Government has power and authority of regulatory control. New York extended the fire-town area to all towns in Essex County. Mississippi authorized the State forestry commission to undertake fire control on State-owned lands intermingled with private lands, and to report trespass on these State lands, in counties having organized forest protective systems. Indiana, by resolution of the department of public works having the force and effect of law, strengthened fire-protection

rules and regulations in State forests by forbidding various specified acts which might cause fire, or the removal or defacement of fire-warning notices. Violation of these regulations is punishable by fine, imprisonment, or both.

A State planning commission was created by Alabama, with duties that include preparing a master plan for the physical development of the State through the best use of the land. After adoption of the master plan or any part thereof, no State forest may be acquired with State funds unless the proposed location has been submitted to the State planning commission and the report and advice of the commission received thereon.

Minnesota authorized the assumption by counties of certain bond obligations of school districts and towns lying wholly or partly within State reforestation or flood-control projects. Rhode Island in its regular appropriation bill carried an item of \$3,000 for the establishment of a State nursery.

Wisconsin made conservation of natural resources a required subject in the common schools.

STATE COOPERATION

Federal appropriations for cooperative work with the States during the year under the Clarke-McNary Act, as compared with those in 1935 and 1937, are shown in table 19.

TABLE 19.—*Appropriations for State cooperation, 1935-37*

Item	Amount appropriated for the fiscal year—		
	1935	1936	1937
For the prevention and suppression of forest fires, and for the forest-taxation inquiry and the insurance study (secs. 1-3 of the Clarke-McNary law).....	\$1, 573, 619	\$1, 578, 632	\$1, 655, 007
For the distribution of forest planting stock to farmers (sec. 4 of the same law).....	56, 296	56, 379	70, 579
For farm-forestry extension (sec. 5 of the law, administered by the Division of Cooperative Extension).....	51, 354	56, 838	56, 838

¹ Made up as follows: \$1,348,619 from the Agricultural Appropriation Act of Mar. 26, 1934, and \$225,000 from the Deficiency Appropriation Act of June 19, 1934.

Table 20 shows in detail Federal, State, and private funds disbursed by the States or expended under their supervision for the prevention and suppression of forest fires, and the Federal and State funds disbursed by the States for the production and distribution of trees for "windbreaks, shelterbelts, and farm woodlots."

TABLE 20.—*Cooperative expenditures for fire protection and for the distribution of forest-planting stock under the Clarke-McNary Act, fiscal year 1936*

State	For fire protection				For the distribution of forest-planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Alabama.....	\$36, 247. 35	\$10, 357. 00	\$27, 501. 26	\$74, 105. 61	\$137. 75	\$1, 232. 76	\$1, 370. 51
Arkansas.....	38, 720. 00	14, 889. 31	44, 249. 43	97, 858. 74	1, 400. 00	5, 409. 62	6, 809. 62
California.....	139, 980. 09	218, 123. 90	286, 520. 57	644, 624. 47			
Colorado.....					1, 448. 00	3, 898. 32	5, 346. 32
Connecticut.....	14, 520. 00	48, 782. 08	3, 449. 59	66, 751. 67	433. 00	694. 42	1, 127. 42
Delaware.....	1, 500. 00	7, 113. 85		8, 613. 85	1, 400. 00	1, 571. 75	2, 971. 75
Florida.....	67, 760. 00	35, 221. 89	53, 888. 46	156, 870. 35	1, 475. 00	7, 805. 17	9, 280. 17
Georgia.....	62, 000. 00	17, 769. 30	72, 887. 19	152, 656. 49	1, 450. 00	3, 955. 38	5, 405. 38
Hawaii.....	600. 00	4, 375. 62		4, 975. 62	781. 82	781. 85	1, 563. 67
Idaho.....	53, 680. 00	39, 227. 16	120, 508. 20	213, 415. 36	1, 338. 67	1, 615. 29	2, 953. 96
Indiana.....	6, 900. 00	11, 817. 34		18, 717. 34	1, 650. 00	7, 628. 78	9, 278. 78
Iowa.....					1, 400. 00	3, 540. 21	4, 940. 21
Kansas.....					1, 235. 00	3, 345. 60	4, 580. 60
Kentucky.....	8, 206. 03	8, 248. 29		16, 454. 32	1, 400. 00	3, 625. 04	5, 025. 04
Louisiana.....	41, 780. 00	60, 202. 86	23, 155. 83	125, 138. 69	1, 485. 00	3, 888. 14	5, 373. 14
Maine.....	49, 150. 00	153, 395. 61		202, 545. 61	482. 92	482. 91	965. 83
Maryland.....	10, 725. 00	41, 085. 77	138. 50	51, 949. 27	1, 400. 00	4, 483. 47	5, 883. 47

TABLE 20.—*Cooperative expenditures for fire protection and for the distribution of forest-planting stock under the Clarke-McNary Act, fiscal year 1936—Con.*

State	For fire protection				For the distribution of forest-planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Massachusetts.....	\$23,050.00	\$79,198.10	-----	\$102,248.10	\$1,480.00	\$6,562.42	\$8,042.42
Michigan.....	93,425.00	286,491.25	-----	379,916.25	1,490.00	6,691.08	8,181.08
Mississippi.....	44,278.49	22,277.07	\$24,177.53	90,733.09	275.62	745.89	1,021.51
Minnesota.....	85,450.00	204,359.38	-----	289,809.38	-----	-----	-----
Montana.....	22,385.00	17,971.32	55,076.89	95,433.21	1,400.00	4,219.72	5,619.72
Nebraska.....	-----	-----	-----	-----	1,590.00	14,733.31	16,323.31
Nevada.....	2,200.00	211.00	4,999.12	7,410.12	-----	-----	-----
New Hampshire.....	15,430.00	31,658.38	5,324.13	52,412.51	1,495.00	4,131.74	5,626.74
New Jersey.....	24,668.00	120,936.24	-----	145,604.24	1,575.00	10,366.78	11,941.78
New Mexico ¹	2,100.00	506.52	2,254.48	4,861.00	-----	-----	-----
New York.....	56,160.00	235,460.80	-----	291,620.80	1,570.00	10,652.32	12,222.32
North Carolina.....	50,560.00	83,039.99	16,366.35	149,966.34	1,200.00	3,578.95	4,778.95
North Dakota.....	-----	-----	-----	-----	1,490.00	6,788.90	8,278.90
Ohio.....	5,600.00	10,360.50	-----	15,960.50	1,505.00	9,688.46	11,193.46
Oklahoma.....	11,904.68	7,904.72	4,000.00	23,809.40	1,400.00	1,959.82	3,359.82
Oregon.....	92,970.00	118,107.53	153,756.65	364,834.18	1,400.00	1,754.70	3,154.70
Pennsylvania.....	50,440.00	195,151.93	-----	245,591.93	1,520.00	8,475.79	9,995.79
Puerto Rico.....	-----	-----	-----	-----	1,530.00	8,934.24	10,464.24
Rhode Island.....	2,300.00	13,636.40	-----	15,936.40	-----	-----	-----
South Carolina.....	30,240.00	29,271.62	28,323.56	87,835.18	1,400.00	3,322.93	4,722.93
South Dakota.....	700.00	2,573.77	267.34	3,541.11	1,045.00	5,875.25	6,920.25
Tennessee.....	19,600.00	60,363.76	1,498.56	81,462.32	1,400.00	1,949.70	3,349.70
Texas.....	40,550.00	72,154.12	8,331.20	121,035.32	² 1,400.00	2,022.27	3,422.27
Utah.....	-----	-----	-----	-----	1,200.00	2,793.82	3,993.82
Vermont.....	5,700.00	6,804.59	4,221.92	16,726.51	1,400.00	2,231.35	3,631.35
Virginia.....	31,760.00	38,135.69	2,652.95	72,548.64	1,400.00	1,543.91	2,943.91
Washington.....	85,150.00	121,338.85	159,511.22	369,000.07	1,400.00	3,318.45	4,718.45
West Virginia.....	27,100.00	51,521.67	20,277.25	98,898.92	1,260.00	12,944.43	14,204.43
Wisconsin.....	68,750.00	191,085.23	-----	259,835.23	1,400.00	3,897.36	5,297.36
Wyoming.....	-----	-----	-----	-----	1,013.87	2,875.57	3,889.44
Administration and inspection.....	101,120.00	-----	-----	101,120.00	999.98	-----	999.98
Total.....	1,528,359.55	2,671,130.41	1,123,338.18	5,322,828.14	55,156.63	196,017.87	251,174.50 ²
Forest taxation and insurance study.....	45,000.00	-----	-----	-----	-----	-----	-----
Unexpended balance.....	5,272.45	-----	-----	-----	1,222.37	-----	-----
Total appropriation.....	1,578,632.00	-----	-----	-----	56,379.00	-----	-----

¹ Paid in part into cooperative fund.² Cooperation began current fiscal year.

COOPERATION IN PROTECTING STATE AND PRIVATE FOREST LANDS FROM FIRE

Table 20 shows a total of \$3,794,469 of State and private funds spent in cooperative forest-fire protection in the fiscal year 1936. The corresponding totals for the fiscal years 1933, 1934, and 1935 were \$3,141,445, \$3,794,722, and \$4,131,072. Thirty-nine States cooperated; the same number as in the two previous fiscal years. Private expenditures for protection outside of the organized protective system do not appear in table 20; in the aggregate their amount is substantial, but data regarding them are not available.

During the calendar year 1935 approximately 242,591,570 acres of State- and private-forest or potential-forest land were under some form of organized protection from fire. This is the largest coverage ever reported. It compares with 237,000,000 acres protected in 1934 and 221,000,000 acres in 1933, and comprised 56.8 percent of the total (427,000,000 acres) classed as needing protection. The area of protected State and private land reported as burned over was 2,311,430 acres (of which 407,760 acres are classed as not having productive value), as against 3,514,570 acres in 1934, and of unprotected forest lands 27,796,500 acres in contrast to 37,647,820 acres in 1934. The 1,903,670 acres of protected productive forest land reported as burned over comprises 0.78 percent of the forest area protected. Of the unprotected forest area the amount reported as burned over came to 15 percent; and 92.3 percent of all the State and private land burned over was outside of protected units. The number of fires reported on protected units was 54,592, the corresponding number in 1934 having been

61,254. Of the 1935 number, 28.4 percent were reported as incendiary, as against 27.7 percent in 1934.

The substantial gains recorded are to be attributed at least in part to the activities of the Civilian Conservation Corps. Forest-fire improvements made by the Civilian Conservation Corps for the 11 months ended March 31, 1936, included 20,621 miles of telephone lines, 34,147 miles of firebreaks, 37,312 miles of roads and trails, 608 new lookout towers, 296 lookout houses, and many other works of improvement; reduction of fire hazards on 807,839 acres; and a large amount of other roadside and trail cleaning.

There has perhaps never been a time more propitious for extending and making more effective the protection of private- and State-forest land from fire than the present. Many public and private agencies are convinced of the necessity of country-wide and adequate protection. The major stumbling block at present is inadequate funds—private, State, and Federal. It is encouraging that the total budgeted for forest-fire cooperation projects for the fiscal year 1936 exceeded by nearly \$300,000 the 1935 total, and came close to the 1932 high-water mark in spite of a somewhat smaller Federal appropriation than in 1932. The record runs: Fiscal year 1932, \$6,607,000; 1933, \$6,157,000; 1934, \$5,249,000; 1935, \$5,945,000; 1936, \$6,230,000.

A systematic reanalysis of the individual State projects was initiated last year, and action was started looking to increased coverage and higher standards of performance. The estimates of the cost of adequate protection are being revised in all States, following the formulation of plans for organization lay-outs, improvements, and equipment which may be expected to supply the degree of protection needed for successful forest management in each forest type.

COOPERATION WITH STATES IN TREE PLANTING

During the calendar year 1935, 26,150,197 trees were distributed by States cooperating under section 4 of the Clarke-McNary law for planting in windbreaks, shelterbelts, and farm wood lots by private landowners. This was 29 percent more than in 1934. The total number of States cooperating was 40, together with Puerto Rico and Hawaii. The States leading in the number of trees distributed for farm planting under the cooperative projects were New York, Georgia, Indiana, Puerto Rico, Pennsylvania, Florida, West Virginia, Ohio, Wisconsin, and Nebraska, each of which distributed more than a million trees.

During this same period a total of 107,000,000 trees were planted by the Civilian Conservation Corps on private and State land.

The maximum initial Federal allotment to each State for the fiscal year 1936 was again reduced, this time to \$1,400. Fortunately the 1937 appropriation increase of \$14,200 makes it possible to bring the amount up to \$1,600 for the current fiscal year.

Approximately 26,000 acres were added to forest plantations on farms during the fiscal year as a result of these cooperative projects.

COOPERATION WITH STATES IN FARM FORESTRY EXTENSION

The year brought increased activity in cooperative farm-forestry extension work. This work is conducted by the States with the aid of Federal cooperation under section 5 of the Clarke-McNary law, administered by the Extension Service with the cooperation of the Forest Service. In 36 States and 1 Territory there were employed in the calendar year 1935, 44 forestry specialists who received the aid of 2 Federal extension foresters—an increase of 3 States and 6 State specialists over the number in 1934. Including the allotments of State funds, a total of \$130,885 was expended in 1935 for farm-forestry extension work.

The management of farm woodlands for increased income and the planting of small forest trees to utilize low-grade lands better or to check soil wastage were the leading forestry projects, in which 13,779 farmers made selective cuttings in their timber stands, 7,179 made improvement thinnings, 11,631 planted small trees for timber production on 56,891 acres, 11,856 planted trees to establish windbreaks and 9,117 to control soil erosion, and 91,716 cooperated in preventing forest or woodland fires. More than 40,000 followed other recommended forestry practices, relating to such matters as the production of maple sirup and of naval stores, estimating and appraising timber, treating timber to resist decay, and marketing forest products.

An increase of 1,401 boys and girls enrolled as members of 4-H forestry clubs brought the total membership to 14,830, an increase of 10 percent; the number

completing their projects was 11,566, or 78 percent—the highest record yet attained. Their activities consisted largely in growing and planting forest-tree seedlings, thinning and weeding forest stands, and protecting farm woodlands from fire.

COOPERATION IN ACQUIRING AND DEVELOPING A NATIONAL SYSTEM OF STATE FORESTS

The Fulmer Act was signed by the President on August 29, 1935. It is a result of cooperative effort by all State foresters throughout the country, the United States Forest Service, and other National and State forestry agencies to build up a stable, adequate, and effective program of State-forest-land management and use. What the law contemplates has the approval of all outstanding forestry interests. It authorizes effective Federal cooperation with the States for the purpose of stimulating the acquisition, development, and proper administration and management of State forests, and coordinates Federal activities for furthering a program of stable forest-land ownership.

The Secretary of Agriculture is authorized to enter into cooperative agreements with appropriate officials of any State that can qualify, for acquiring in the name of the United States and turning over for administration such forest land as in his judgment the State is adequately prepared to administer, develop, and manage as State forests. The law requires the enactment and enforcement by States of appropriate laws to bring about the handling of tax-delinquent lands on a sound social and economic basis; and under the act no cooperation will be extended after 1942 to States which lack tax-delinquency laws satisfactory to the Secretary of Agriculture.

The cost of the land to the Federal Government will be returnable to the Treasury through payment of 50 percent of the income from the property.

The act made no funds available, but it authorized an aggregate appropriation of \$5,000,000. The land-planning committee of the National Resources Board, in its report on a proposed balanced forest-land acquisition and development program, advocated State acquisition by 1960 of approximately 77,000,000 acres of land best suited to forest cover. Of this amount the States now own and have placed under proper management 17,000,000 acres. That leaves 60,000,000 acres to be acquired within the next 24 years to comply with the program.

To a very marked degree public interest in forestry practice is in proportion to the area of properly handled public forests in a State. The financial assistance and leadership of the Federal Government as contemplated by the Fulmer Act will aid materially in securing continuity of purpose in developing the forest-land resources of the entire country. All proposed purchases under the law will be subject to approval by the National Forest Reservation Commission.

It is believed that at least 35 States will apply immediately for cooperation if money becomes available. An appropriation of \$5,000,000 would provide approximately \$140,000 for each State if equally distributed; enough to purchase perhaps 28,000 acres. That would provide a beginning in the development of a forest-land-use policy and program for the country, with far-reaching benefits.

A manual of policy and procedure under the act has been prepared cooperatively by the States and the Forest Service, and in a number of States suitable tracts of land have been examined and selected as desirable for acquisition and development. Properly financed and administered, the Fulmer Act will constitute a major step in the upbuilding of a comprehensive and satisfactory forest policy for the entire Nation.

PRIVATE FORESTRY

The reports of 1934 and 1935 gave details of cooperation by the Forest Service under article X of the Lumber Code. This cooperation was the first major effort of the Forest Service in many years to provide general technical assistance in the field of private forestry. Upon the abolition of all codes on May 27, 1935, it was decided that, insofar as possible, the work in the private forestry field should be continued and developed. Many considerations governed this decision. First of all, it was essential to maintain such improvements in forest practices and in attitude toward conservation on the part of operating owners and the forest industries as had developed under the operation of article X. Much of the land-use planning of Federal and State agencies, and many of the related activities, involved forest land in private ownership, so that there was need for technical leadership and correlation of the forestry phases. Increasing attention

was being required by existent and proposed activities in the fields of Federal and State forest-land acquisition, forest credits, cooperative fire protection, and the like, all of them having an important bearing on the future of private forest lands. Further, the private forest lands of the nation, which represent some 80 percent of the total commercial-forest area and some 90 percent or more of the total production capacity of our forests, were receiving only a small share of all funds being expended for technical forestry purposes and forest protection.

The situation justified the establishment of a division responsible for private forestry cooperation. By the close of the fiscal year 1936, 5 of the 10 national-forest regions had established private forestry cooperation as a recognized activity, with full-time personnel.

The Division of Private Forestry proposes to do much more than promote better forest practices here and there. During the year extensive inventory data were collected from many sources, and these data are being compiled for the purpose of analyzing the forest resources, ownerships, operating facilities, and sociological bearings of private forest land, by regions. In a number of instances, primarily in the Lake States, working plans of management were roughly prepared for units made up of one or several holdings, to show what can be done with these properties under sustained-yield management. The plans have been presented to the dominant owners and operators with a view to securing their acceptance of the plans and the conversion of current and contemplated operations from a liquidation to a sustained-yield basis. Several more plans of this type are in various stages of completion. It seems probable that where a reasonable and practicable plan can be worked out on the basis of the specific requirements of the individual situation many owners and operators may be willing to forego certain immediate benefits in order to obtain more permanent and stable future operation.

As a preliminary step to a fuller development and application of such working plans, the Division of Private Forestry is in the process of collecting and compiling extensive data and preparing maps to show the Nation-wide occurrence of operable forest units, both private and joint public-private, that have sustained-yield possibilities. As conditions and facilities permit, working plans will be prepared for such areas.

During the latter part of the year definite steps were taken for the establishment of comparable participation in the field of farm woodlands, in conjunction with the Extension Service of the Department. An inventory and plan for woodland management and utilization in Dubois County, Ind., was completed. The inventory for a cooperative farm-woodland project involving one county in New Hampshire and one in Vermont was under way at the close of this year.

The Division of Private Forestry offered its cooperation, with the forest experiment stations, in determining standards and payments for tree planting under the agricultural conservation program. Near the close of the year the Division assumed responsibility for the technical forestry standards of performance and for field inspections applicable to a naval stores conservation program under the Soil Conservation and Domestic Allotment Act, this program being administered in conjunction with the Agricultural Adjustment Administration.

THE PLAINS SHELTERBELT PROJECT

The Plains shelterbelt project was inaugurated July 21, 1934. Its purposes were to stimulate tree planting in the Great Plains region and to provide relief in that drought-stricken area by giving employment to needy residents.

Farm wood-lot and shelterbelt planting has been common in the region for more than 50 years, stimulated by Federal and State encouragement and impelled by individual desire for crop and livestock protection and a more comfortable and pleasant environment. Many failures occurred not because of the inability of trees to survive the climatic and soil conditions, but through unwise choice of species and lack of care and protection.

The Forest Service undertook to plant in a restricted area 100 miles wide, running north and south through the Great Plains section of North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. Previous to planting, much exploratory work was done to study the effects of the 1934 drought on earlier plantings. This study aided materially in the selection of drought-hardy and long-lived species. Extensive surveys were made to correlate soils, water tables, rainfall, evaporation, and pathological conditions with safe conditions for tree establishment. These surveys formed the basis for locating the zone.

Land policies.—Negotiations with landowners were started in November 1934 to obtain land for the plantings in the spring of 1935. This land was obtained on a contract under which the landowner was paid a yearly rental, based upon the productive value of the land. The contract included an option to purchase the land, or to acquire an easement thereon, at a stipulated price, the lease payments to be applicable on the purchase price.

After July 1, 1935, the lease and option contract was modified by reason of a cooperative agreement between the Agricultural Adjustment Administration and the Forest Service, providing that the land devoted to shelterbelt plantings would be accepted as crop-reduction acreage. No rentals were paid by the Forest Service on these lands.

On January 6, 1936, the Agricultural Adjustment Act was declared unconstitutional by the United States Supreme Court, and it was necessary to renegotiate land for 1936 planting under a new form of contract. The Forest Service agreed to furnish the stock, plant the trees, and maintain the plantings by such necessary care as cultivation, to June 30. The landowner agreed to furnish the land and fence material and prepare the land for planting.

In addition to the field shelterbelt, which would be controlled by the Forest Service, the landowner was allowed an additional farmstead or wood-lot planting of not to exceed 3 acres, to be maintained and cared for at his own expense. This resulted in an approximately 50-50 cooperative arrangement, and proved to be a most satisfactory basis of cooperation from the standpoint both of the Government and of the individual landowner.

Nurseries.—Leased commercial nurseries operated by the Forest Service were started in the spring of 1935 in all States of the shelterbelt zone. All seed for nursery production was collected or purchased by the Forest Service, with special emphasis placed upon known source of the seed. Most of the seed was gathered within or in close proximity to the shelterbelt zone. All the stock planted in 1935, with the exception of collected wildings, was purchased from commercial nurseries. Subsequent plantings were made almost entirely from stock produced or collected by the Forest Service.

On June 30, 1936, nursery inventories from the six States showed approximately 75,000,000 seedlings growing in leased nurseries. In view of the very unfavorable weather conditions during the summer, probably not more than 50 percent of these seedlings will develop into usable stock.

Planting accomplishments.—In the spring of 1935, 232 shelterbelt strips 10 rods wide, averaging about one-half mile in length, were planted in the six States. In the same year 1,920 farmstead plantings averaging $2\frac{1}{2}$ acres each were made in the four Northern States. These plantings comprised 7,514 acres on 2,152 farms, and required 5,615,183 trees.

In the spring of 1936, 2,212 shelterbelt strips, averaging one-half mile in length, and 878 farmstead plantings, averaging 1.6 acres, were established in the six States. This made a total of 24,521 acres planted on 2,212 farms. In addition, 629,810 trees were used in planting blank rows and replacing dead trees in the 1935 strips, making a total of 18,155,878 trees planted in 1936.

When the fiscal year closed, June 30, 1936, 32,035 acres had been planted on 4,364 farms. Out of the 23,771,061 trees planted, 19,281,592 were alive and growing; an average survival of 81 percent.

Cultivation.—During the summer of 1935 all shelterbelt strips were cultivated with an average of five cultivations per strip. In 1936 each strip received an average of two and one-half cultivations prior to July 1.

Status of the project on June 30, 1936.—The situation when the fiscal year ended may be thus summarized: \$170,000 available for liquidation purposes; 1,277.8 miles of shelterbelt strips planted; 6,474 acres of farmstead plantings established; 4,364 farms on which plantings were made; 23,771,061 trees, cuttings, and nuts planted; 19,281,592 trees, cuttings, and nuts growing; 75,000,000 seedlings growing in nurseries; 2,660 unsolicited applications for shelterbelt plantings on file.

The results clearly demonstrate the entire feasibility of this type of work in the Great Plains region, where an urgent necessity exists for an extensive tree-planting program. Expansion of the work over a more extensive part of the region is recognized as a major factor in water and soil conservation and in micro-climatic amelioration.

Tables 21, 22, and 23 show the record by States.

TABLE 21.—*Shelterbelt plantings, 1935*

State	Shelterbelt strips				Farmsteads			Total			Survival July 1, 1936
	Miles	Acres	Farms served	Trees planted	Acres	Farms served	Trees planted	Acres	Farms served	Trees planted	
Texas.....	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Percent
Oklahoma.....	1.0	20	2	13,880				90	2	13,880	71.6
Kansas.....	13.5	270	23	187,495				270	23	187,495	71.6
Nebraska.....	24.0	480	47	300,000	126	64	59,400	606	111	250,400	57.8
South Dakota.....	20.5	410	32	307,559	861	319	657,558	1,271	351	965,058	64.3
North Dakota.....	28.0	560	54	498,250	2,739	1,063	1,910,000	3,269	1,037	2,405,250	83.0
Total.....	38.0	760	74	632,600	1,288	584	1,148,500	2,048	608	1,781,400	71.6
	125.0	2,500	232	1,839,725	5,014	1,920	3,775,453	7,514	2,152	5,615,183	77.3

TABLE 22.—*Shelterbelt plantings, 1936*

State	Shelterbelt strips				Farmsteads			Total			Survival July 1, 1936
	Miles	Acres	Farms served	Trees planted	Acres	Farms served	Trees planted	Acres	Farms served	Trees planted	
Texas.....	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Percent
Oklahoma.....	170.0	3,400	343	1,756,808	200.0	150	100,132	3,600.0	343	1,870,888	76.3
Kansas.....	157.0	3,140	282	1,281,694	154.7	110	107,848	3,294.7	282	1,486,748	79.8
Nebraska.....	224.5	4,491	467	3,257,700	156.0	88	140,400	4,647.0	467	3,583,500	78.5
South Dakota.....	150.5	3,009	301	2,217,633	302.0	162	219,752	3,311.0	361	2,531,327	76.7
North Dakota.....	235.8	4,717	445	4,484,000	411.9	222	362,560	5,128.9	445	4,905,570	93.8
	213.0	4,304	374	3,378,616	235.3	146	178,925	4,539.3	574	3,756,745	79.0
Total.....	1,152.8	23,061	2,212	16,416,451	1,459.9	878	1,109,617	24,520.9	2,212	18,155,878	82.4

TABLE 23.—All shelterbelt planting to July 1, 1936

State	Shelterbelt strips				Farmsteads			Replants on 1935 strips	Total			Survival July 1, 1936
	Miles	Acres	Farms served	Trees planted	Acres	Farms served	Trees planted		Acres	Farms served	Trees planted	
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Percent</i>
Texas.....	171.0	3,420	345	1,780,688	200.0	150	100,132	3,948	3,620.0	345	1,884,768	76.2
Oklahoma.....	170.5	3,410	305	1,469,189	154.7	110	107,848	97,206	3,564.7	305	1,674,243	78.9
Kansas.....	248.5	4,971	514	3,487,700	282.0	152	199,800	155,200	5,253.0	578	3,842,700	77.1
Nebraska.....	171.0	3,419	333	2,525,133	1,163.0	481	877,310	113,942	4,582.0	652	3,516,385	73.2
South Dakota.....	263.8	5,277	499	4,982,250	3,150.9	1,225	2,272,560	60,310	8,427.9	1,502	7,315,120	91.5
North Dakota.....	253.0	5,064	448	4,011,216	1,523.3	680	1,327,425	199,204	6,587.3	982	5,537,845	77.9
Total.....	1,277.8	25,561	2,444	18,256,176	6,473.9	2,798	4,885,075	629,810	32,034.9	4,364	23,771,061	81.2

RESEARCH

Departmental recognition of the intimate relationship between conditions on the range and the social and economic structure of the West caused the Forest Service to review the range situation and to recommend a program of constructive action for betterment. The need for such a study was evident in the progressive wastage and physical destruction of the natural range, in the extent to which overgrazing was causing increased erosion and recurrent floods, and in the adverse economic consequences. The results of this study were laid before Congress in response to Senate Resolution 289, and were published as Senate Document 199, *The Western Range*. In many ways it is a companion report to the so-called Copeland report of 1933, *A National Plan of American Forestry*, which dealt with the forest situation.

The first amendment to the McSweeney-McNary Forest Research Act since its passage in 1928 was approved in the closing days of the Seventy-fourth Congress. It authorizes a Great Plains Forest Experiment Station, badly needed to provide authentic information on successful tree growing for the "treeless" plains and prairie region. While the forestry problems of this section are vastly different from those of naturally forested regions, they are none the less acute and pressing.

Scarcely less is the need for a forest experiment station in our American tropics. Keen interest has been aroused of late in the economic and social conditions in Puerto Rico and other tropical island possessions and in the part which forestry can play in correcting them. A sound program will undoubtedly call for reforestation of much denuded and eroding land, necessitating information on many species whose silvical characteristics and requirements are almost wholly unknown. Authorization for such a station is carried in the original McSweeney-McNary Forest Research Act.

A new Federal policy and program of national flood control was established in the Flood Control Act of 1936. This act states that investigations and improvements of rivers and their watersheds for flood control are in the public interest, and proposes that the Federal Government improve navigable waters and their tributaries, including their watersheds, for flood-control purposes if the benefits to whomsoever they accrue are in excess of costs and if the lives and social security of people are adversely affected. It also establishes the Department of Agriculture as the Federal agency to undertake "investigations of watersheds and measures for run-off and waterflow retardation and soil-erosion prevention on watersheds." This authority is corollary to the responsibility of the War Department for work on the rivers. Since the work concerns in part forests and other wild lands, the active participation of research foresters will be needed.

FOREST-MANAGEMENT INVESTIGATIONS

An important addition to the experimental forests is a tract of some 1,600 acres at the National Agricultural Research Center at Beltsville, Md. This area, made available through purchase by the Resettlement Administration, will provide a means for close contact with other research agencies of the Department and so will strengthen work on common or closely allied problems. The Resettlement Administration has taken options on several other tracts which are to be made available for work by the forest experiment stations. Several new experimental forests were established on the national forests. The largest was in the Siskiyou National Forest, Oreg. It contains a high percentage of the valuable Port Orford cedar, which is being rapidly exploited on the west coast today. Other areas were formally set aside for research in Louisiana, Minnesota, and New Mexico, and some of the existing areas in Minnesota, North Carolina, and Georgia were enlarged. The acquisition program of the Forest Service also made it possible to round out several experimental forests by extinguishing private titles to interior holdings which threatened to interfere with the research program. On the other hand the establishment of mining claims on some of the experimental forests in the West, where under present economic conditions gold mining has been very active and areas are being prospected or worked that under normal circumstances would be passed by, has greatly reduced the value of these forests for research purposes.

SILVICULTURAL INVESTIGATIONS

Noteworthy progress was made in artificial forest regeneration. In the South a long-felt and urgent need in the planting field was met with the publication of a technical bulletin summarizing present knowledge on nursery and planting technique, based on thoroughgoing research and practical experience. This bulletin is particularly timely in view of the elaborate and extensive reforestation program, both public and private, now under way in the South and is a comprehensive handbook on nursery and planting methods.

In the intermountain region careful studies of root development helped to clarify the reasons why naturally sown seedlings survive better than transplanted nursery-grown stock. The former produce taproots in 1 year averaging on some sites 27 inches in length, whereas planted seedlings, invariably root-pruned in the nursery, fail to produce the taproot needed to keep them in contact with moist soil and consequently suffer extensively from drought despite fibrous and apparently better-developed root systems.

In determining silvicultural principles as a basis for growing timber as a crop, both long-time experiments and shorter, more intensive studies are needed. Last year increasing and profitable use was made of the latter type of experiment, particularly in studies of natural regeneration. By this method, instead of attacking a complex problem as a whole it is broken down into its component parts and the answer found piecemeal. For example, in the Southwest it was found that seed protected by screens against rodents germinated promptly and had excellent survival in spite of adverse weather conditions, whereas unprotected seed was promptly consumed. With this information at hand, the need for rodent control on timber-sale areas becomes apparent. In the Northwest, similar investigations clarified the parts played by various biotic agents, such as rodents and fungi, and by such physical factors as high surface temperatures and drought, in the regeneration of western white pine and Douglas fir.

In the western white pine type, for example, the studies showed that seedling reproduction of all species is endangered on the more severe sites by increasingly high surface soil temperatures after clear cutting, while on more sheltered areas clear cutting distinctly favors the relatively hardy and commercially valuable western white pine over most of its aggressive but less valuable associates. Such illuminating facts on the role of individual factors are proving extremely helpful in clarifying and interpreting the results obtained in trial cuttings, and help to furnish the foundation for sound silvicultural practices.

Another physical factor often decisive in determining whether or not natural regeneration can be successfully obtained under specific forestry practices is that of seed-bed conditions. In the South, Lake States, and Northwest, disturbance of the forest floor resulting in exposure of mineral soil through either cultivation or fire was found to favor prompt seed germination. Needle litter often prevents seed from reaching moist soil, and its moisture and temperature fluctuate rapidly and over a dangerously wide range. Some litter, however, is often desirable to furnish protection from birds and other seed eaters.

Continued investigation in the Lake States of methods of regeneration of jack pine, now widely used for pulpwood, show that this presents a much more complicated problem than was at first believed. Clear cutting or diameter-limit cutting in jack pine does not result consistently in satisfactory natural reproduction, partly because the cones of this species remain long closed on the trees and partly because of unfavorable seed-bed conditions. Clear cutting of jack pine in small areas resulted in satisfactory reproduction only when cones in slash spread over exposed mineral soil were opened by the heat of the sun. If this slash is too heavy, however, it affords a serious mechanical obstruction to the young seedlings. In heavy cuttings, therefore, partial burning of the slash is helpful.

Progress continued in the development of stand improvement and cultural methods, now of immediate importance in connection with work of the Civilian Conservation Corps and various other emergency groups. Up to June 30, 1935, the Civilian Conservation Corps alone had removed dead, defective, and worthless trees and thinned and improved overcrowded stands on nearly 2,000,000 acres. Research contributed materially to this program by suggesting and checking methods, aiding in the training of foremen, and in similar ways. During the year the value of girdling overtopping hardwoods in pulpwood stands, an extensively employed stand-improvement practice throughout the Northeast, was demonstrated; 30-year-old plots indicate that initial investments

of \$2 to \$2.60 per acre will result in increased yields in spruce and balsam pulp of \$27.50 to \$50 per acre at the end of 40 years for girdled over ungirdled stands.

Selection types of cutting, increasingly used in various sections of the country, were given further extensive tests. In northern hardwoods, in both New England and the Lake States, windfall and other losses were found to decrease with increasingly light selection cuts. In the Northwest investigative work has indicated that light and frequent cuts are practicable as well as silviculturally desirable in ponderosa pine. In the Douglas fir and western white pine types of the same general region, however, indiscriminate selective logging frequently leaves the ground occupied by a worthless stand of slow-growing decadent and defective trees.

At the California Forest Experiment Station work was undertaken on the stimulation of root production, using indolacetic acid after the technique developed at the California Institute of Technology and the Boyce-Thompson Institute. Investigators in this field have succeeded in inducing root growth almost at will through the application of synthetic substances similar to growth hormone. Success in this field promises great possibilities not only through increasing field survival where vigorous root development is essential but also through the vegetative propagation of desirable species. Only a few forest trees and shrubs are now capable of taking root from planted cuttings.

Growing recognition of the importance of trees and other forest plants as game foods, in shelterbelt planting, and in vegetative control of erosion has stimulated interest in many species heretofore neglected. During the year the Lake States Forest Experiment Station prepared, in collaboration with the Bureau of Biological Survey, a description of the methods of propagation, site requirements, and value of various game-food species common in the Lake States region. Stress was given to proper methods of seed storage and treatment to stimulate germination, much of which was based on the results of recent experiments.

Planting also enters into the reclamation in the Lake States of the immense areas of aspen, once regarded entirely as worthless brush, which followed the original white and Norway pine stands. Aspen, easily the most aggressive tree in the Lake States region, has occupied promiscuously all kinds of soils. On sandy soils conversion to pine is desirable and on the lightest of these soils forest planting with conversion in view has been reasonably successful. But on the sandy soils of better quality it has now been conclusively demonstrated that successful conversion by planting is impossible without repeated weedings. On the heavier soils aspen can be grown profitably, and thinning experiments indicate the feasibility of increasing the rate of growth of selected trees and consequently the percentage of veneer logs, which command a market price comparable to that of the best pine.

FOREST GENETICS

During the year details of the physical transfer of the property and records of the Institute of Forest Genetics were completed. This institute, given to the United States by its founder, James G. Eddy, of Seattle, is now part of the California Forest Experiment Station. Parallel work was also assured in the East through congressional approval of genetical studies at the Northeastern station which permit carrying forward the highly successful research on poplars begun by the New York Botanical Garden under the sponsorship of the Oxford Paper Co., of Maine. It is hoped to extend this breeding work to other valuable hardwoods.

Preliminary studies of the Institute of Forest Genetics have resulted in the production of a number of hybrid pines, the most promising being *Pinus attenuata* \times *P. radiata*, the progeny showing in early life the rapid growth of the pollen parent, Monterey pine, combined with the frost resistance of the seed parent, knobcone pine. Another interesting and potentially valuable cross is that of *P. jeffreyi* \times *P. ponderosa*, the progeny showing hybrid vigor and indicating increased frost resistance. In connection with studies of species characteristics and the segregation of geographic races, the institute now has at its field station near Placerville, Calif., what is believed to be the world's most complete assemblage of species and geographical races of the genus *Pinus*. The collection includes approximately 100 species and named varieties and, in addition, innumerable climatic forms of many species. Extensive records on growth, taxonomic characteristics, flowering and fruiting, and injury are being kept on

all species or geographic strains. In a number of cases records of this sort are being kept on the progeny of known and tagged individual seed trees in an effort to work out the relationship between visible characters of seed trees and the nature of their progeny. It has already been demonstrated that even within local geographical strains various individual trees vary markedly in their ability to produce progeny of superior quality.

One interesting advance is definite proof that budding and grafting is possible with pines, ponderosa pine having been successfully top-grafted and several species successfully budded on ponderosa root stock. This opens the possibility of vegetative propagation of desirable strains. Another interesting advance is the discovery, borne out by recent observations at the Southern Forest Experiment Station also, that conifers, particularly pines, produce fertile flowers at the very early age of 2 to 5 years. Apparently the time necessary to run through a breeding cycle, long considered a major disadvantage in tree breeding, has been greatly exaggerated, and indeed may be only slightly longer than that required with a number of other major crop plants and farm animals.

FIRE, NAVAL STORES, AND RELATED INVESTIGATIONS

Studies to aid in the development of better fire-control organization and the improvement of detection technique, and to provide better methods of determining fire danger, continued to facilitate the work of administrative agencies in fire protection. An interregional fire conference held at Spokane, Wash., gave opportunity for discussion of the research contribution to date, resulting in an increased appreciation of the possibilities and in stimulation of additional effort.

Continued damage studies in the Northeast showed heavy delayed mortality. The fire resistance of individual species was found to be closely correlated with various bark characteristics and peculiarities. Barks with high moisture content and a low ratio of dead to live bark (as in beech and balsam fir) are relatively low in fire resistance.

The value of the naval-stores research conducted by the Southern Forest Experiment Station was amply demonstrated this year when the provisions of the amended Soil Conservation Act were extended to the production of naval stores. In developing the conservation methods to be applied in naval-stores operations, practically every phase of previous investigations was drawn upon. Research continued to yield information paving the way for more efficient chipping, increased yields, and better management of turpentine stands. Intensive studies clarified the influence of air and soil temperatures, particularly air temperature, on gum flow, and the varying response between longleaf and slash pines. This knowledge permits adjustment of chipping schedules to obtain maximum yields in the shortest period of time. One of the most interesting developments is that higher gum yields can be obtained on fast-growing, very vigorous slash pines by deep chipping; chipping 1 inch deep produces about 24 percent more gum than one-fourth inch. There is no indication thus far that chipping $\frac{3}{4}$ to 1 inch deep is too severe for slash pines ranging in growth rate from 1 to 10 rings per $\frac{1}{2}$ -inch radius, although this fact and the possibility of dry facing require further study. Chipping with sharp hacks was found to give approximately 15 percent more gum than when the hacks were dull.

The statistical analysis of forest problems, first used in forest mensuration, is now being applied widely throughout the whole field of silvical research. Since measurements of volume, growth, and yield lent themselves readily to mathematical treatment, it was natural that the statistical method was first applied in preparing volume and yield tables. The successful application of these methods in forest mensuration, and especially the development of new technique by R. A. Fisher of England adaptable to a great variety of biological research, have given impetus to the use of statistical tools in every line of forest investigation. Indeed, the increasing application of biometrical methods to forest problems, resulting in sound experimental design and greatly facilitating thorough and accurate interpretation, is perhaps the most promising trend in forest research at the present time.

To the series of growth and yield tables being prepared for fully stocked, even-aged stands in the major forest types of the country were added those for Sitka spruce-western hemlock of the Pacific coast, the upland oaks of the East, and red gum of the Mississippi Delta. One set of these, for the Sitka spruce-western hemlock type of the "fog-belt" of the Pacific Northwest, is remarkable for the spectacular yields indicated. The potential productivity of this type, which occupies the lower elevations near the coast, is illustrated

by the indicated remarkable volume of 36,000 cubic feet per acre at 150 years on the best sites, whereas a comparable value for Douglas fir stands is 24,000 cubic feet. The tables for the other two types, upland oaks in the East and red gum in the Mississippi Delta, are especially noteworthy for the difficulties overcome in their preparation and because they are the first to be prepared for hardwoods. The chief source of difficulty in the oak study arose from the large number of species present and the wide variation in composition resulting from specific differences in growth rate, shade tolerance, and site requirements. These disturbing factors were present to a less extent in the red gum study, but there still remained the problem of deriving adequate volume formulas for the irregularly formed hardwoods. The solution of these and other problems, such as the presence of a sprout growth in the plots, involved the further modification of methods previously worked out for estimating growth and yield of mixed conifer stands and marks a real advance in mensurational technique.

RANGE RESEARCH

Mention has already been made of the Norris report (S. Doc. 199), The Western Range, a Great but Neglected Natural Resource, prepared during the year. It is the first comprehensive survey ever made of the entire western-range situation. It brings out the almost universal depletion, averaging 52 percent, on the 728 million acres of range lands. This astonishing reduction in vegetative productivity has resulted from excessive stocking, recurrent drought, financial handicaps, unsuitable land policy, and related causes. The report deals in detail with the complex and intermingled uses of range land for the production of forage for domestic livestock and wildlife, for watershed protection, for recreation, and the like. It also outlines a constructive program for remedying the current unsatisfactory situation.

Cost-of-production studies at the Southwestern Forest and Range Experiment Station brought out significant results. An 11-year record of an average of 494 breeding cows at the Santa Rita Experimental Range in southern Arizona showed that it cost \$20.81, including interest, to maintain a cow on the range yearlong, and the average return per cow was \$26.91, leaving a net of \$6.10 per head. The average cost of producing a calf was \$25.11 and the net return, on the basis of an 83-percent calf crop, \$7.44. The practice of selling all marketable livestock annually, except foundation animals, to assure adequate feed for the breeding herd was an important factor in the final profit.

Salting tests at the Jornada experimental range in southern New Mexico disclosed that cattle, contrary to popular belief, instead of alternating between salt and water when salt grounds are remote from water, often came into the salt grounds, licked for a short time, and then left, grazing in an opposite direction from water. By judicious use of salt as a lure, tobosa grass was utilized 50 percent; three-awns, 70 percent; and burro grass, 20 percent. Without such salting, and other things being equal, only about 30 percent, 50 percent, and 10 percent of these respective grasses are grazed.

Preliminary results from investigations by the Intermountain Forest and Range Experiment Station, in cooperation with the Bureau of Animal Industry, disclose important trends on grazing spring-fall ranges during drought at the United States Sheep Experiment Station in southeastern Idaho. Conservative fall grazing alone is not harmful and favors cover maintenance on fully vegetated areas. Continuous spring use of forage is injurious, and regardless of intensity, results in decreases greater than those attributable exclusively to drought. Complete spring protection from grazing during a drought year, followed by moderate use the following year, aids revegetation of partially depleted areas. If paddocks are grazed in the spring of the drought year, deferment the subsequent season is essential to their maintenance.

Studies at the Intermountain Station showed that fine-leaved sagebrush is more susceptible to injury from fall grazing or burning than are perennial bunch grasses, for the reason that the sagebrush stores 57 percent of all reducing sugars, sucrose, and starch in the current stem-leaf growth, 23 percent in the main stems and secondary branches, and only 20 percent in the roots; whereas in bunch grasses virtually 100 percent of the fall carbohydrate storage is in the root-sprout crowns, since the herbage is cured and physiologically inert from about July 15. Thus heavy grazing or burning in the fall may greatly impair sagebrush growth but causes little injury to cured grasses.

Paddock studies at the Intermountain Station emphasize that sheep remain thrifty on exclusive desert-range forage. Representative animals were grazed at the Desert experimental range in western Utah in six paddocks for 59 days during the winter months; rams gained 0.83 pound per head, ewes 3.64 pounds, and lambs 7.95 pounds. These gains were made by utilizing approximately 47 percent of the current year's growth of vegetation, the more palatable of which consisted mainly of shadscale, curly grass, ricegrass, white sage, dropseed, and bud sagebrush.

A forage inventory made by the California Forest and Range Experiment Station at the San Joaquin experimental range identified 80 species of the complex foothill vegetation of the State as important. Long heron's bill (*Erodium botrys*) and foxtail fescue comprise one-half of the bulk of forage produced. These two, with the annuals soft chess, popcorn flower (*Plagiobothrys*), and "tarweed" (*Hemizonia*) compose slightly over 60 percent of the vegetation.

Grazing experiments by the Northern Rocky Mountain Forest and Range Experiment Station, in cooperation with the Bureau of Animal Industry, showed on moderately used range near Miles City, Mont., less low-value grass, 20 times more medium-value grass, and 10 times more high-value grass than on overgrazed range. Only about 10 percent of the vegetation on the overgrazed range can be classed as good forage, as against 50 percent on the moderately grazed.

Measurements of herbaceous vegetation at Miles City in 1935 revealed that the 1934 drought decreased blue grama and western wheatgrass 75 percent each, buffalo grass 79 percent, needle-and-thread 59 percent, and niggerwool 12 percent. The flowering of western wheatgrass and blue grama in the spring of 1935 was both retarded and decreased.

Range investigations were started by the newly organized Rocky Mountain Forest and Range Experiment Station. For example, the determination of the vegetative cover, the relative forage value of different types of vegetation, and the present condition of each type are already under way, with measurements on 30,000 sample plots.

FOREST-PRODUCTS RESEARCH

The efficient harvesting of the timber crop and its conversion into an immense variety and volume of useful products is an essential part of making the forest lands of the country contribute their full share to the welfare and support of its people. The Forest Products Laboratory is devoted to scientific and technical research designed to aid in deriving better and cheaper products from the forest; to lessen waste in the harvesting, conversion, and utilization of forest crops; to put timber growing on a more profitable basis; and to make the forests contribute to the secure and permanent support of a larger share of the Nation's population. A scientific and technical plant unrivaled in its field and housed in a large and thoroughly modern building provides research facilities which are not now being used at full capacity. The operating appropriation for the laboratory last year was considerably less than in 1930. Many vacancies in the ranks of the trained personnel due to death, resignation, or transfer have not been filled, and the loss has been offset only in part by the temporary help employed through emergency and relief allotments.

MEETING MODERN BUILDING NEEDS WITH WOOD

The development of a prefabricated all-wood house construction system, initiated last year, was continued; the flexibility of the proposed system was enlarged by establishing its adaptability to two-story as well as to single-story construction, to gable roofs as well as to flat roofs, and to conventional styles of architecture as well as to the modernistic. Continued studies of laminated or glued-up construction yielded further data required for the design and fabrication of large wooden arches that permit wood to compete for use in buildings where large clear spans are called for. Laminated construction is of particular importance because it utilizes the small lumber sizes readily obtainable from second-growth forests managed on a relatively short rotation.

Improved joints and fastenings for wood have followed the introduction and development of modern metal connectors; in 1935 more than 3,000,000 were used, with the accompanying utilization of 200,000,000 board feet of lumber. Studies on connectors during the year concerned details of design, such as the necessary initial ring-spread, the minimum thickness of material for a connector of a given size, and the like. The application of these data sets up

one more milestone in the progress of timber construction, and another demonstration of the role of research in promoting more efficient utilization.

Modern building methods have complicated the problems arising from moisture in walls. Air-conditioning plants, as a rule, increase the amount of moisture liberated within dwellings, while modern waterproof building papers and heat-insulating materials make the escape of moisture more difficult. The result is that comparatively large quantities of moisture accumulate in the walls of modern dwellings to the detriment of the wall itself, the exterior paint, and the interior decoration. The unusually severe winter of 1935 materially aggravated this type of trouble. Marked progress was made in finding the exact causes and effects of moisture accumulation in house walls, and information was obtained that may lead to the development of means of overcoming or avoiding the difficulties. Information of practical application to house insulation was also obtained on the flow of heat through wood.

Weather resistance and protective methods for plywood are rapidly becoming of importance on account of the increasing use of plywood where it is exposed to the weather. A comprehensive outdoor exposure test was started to determine the ability of different glues to hold veneers together satisfactorily under adverse conditions. A variety of species and thicknesses are included in the test, as well as various methods of protecting the faces and edges of the plywood from checking by means of paints and other coatings. It is expected that the tests will continue over a number of years.

Several important publications in the field of wood fabrication were issued. Chief among these was the wood handbook for architects and engineers, published in September 1935. Its sales by the Government Printing Office have already passed the 25,000 mark. Of importance also were the issuance of a farmers' bulletin on the selection of lumber for farm and home use, and a new publication on the strength and related properties of American woods.

GROWTH, HARVESTING, AND UTILIZATION STUDIES

Studies of the influence of growth conditions upon wood quality indicated a general tendency for wood from second-growth stands of both sugar maple and yellow poplar to be heavier and harder than that from old-growth trees. The wood of second-growth maple was found to have an unusual degree of uniformity, which is a distinct advantage for flooring and many other wear-resisting uses. Study of the development of knots in timber trees and the advantages of pruning off the lower branches while the trees are small was continued. Trees from New Hampshire stands of white pine pruned 40 years ago showed 90 percent of the lumber from the pruned section to be entirely clear of knots. In a study directed toward the growing of timber of maximum strength it was found that the removal of three-fourths of the lower branches from longleaf pine trees resulted in a reduction of both springwood and summerwood formation, but the reduction was proportionately greater in the weak springwood than in the strong summerwood. Examination of commercial white ash with low-, medium-, and high-strength characteristics showed differences not only in density but also in the structure of the individual wood fibers. The results of this study should prove valuable in selecting wood for specialized uses requiring particular strength properties.

Logging and milling studies to determine the minimum sizes of trees economical to cut, and thus guide selective-logging practice on forest lands, were made in softwood and hardwood stands in the Southern States and in New England. For scarlet oak and chestnut the minimum size of tree that pays its way in the Appalachian region was found to be 16 inches; for northern red oak, 14 inches; for yellow poplar, 13 inches; and for white oak, 12 inches. A bulletin setting forth modern methods for the efficient manufacture of dimension stock from New England hardwoods was issued. A more general acceptance of dimension stock as a suitable substitute for long, wide lumber would aid both in the conservation of the better hardwood timber and in stabilizing many secondary wood-using industries. As an aid to improved practices among operators of small sawmills, comparative studies were begun of the outputs of felling, skidding, hauling, and milling crews. Such studies furnish a reliable means of estimating logging costs, and have practical application in the appraisal of stumpage and in determining sound and profitable standards of utilization.

The naval-stores industry, which furnishes employment for more than 50,000 people, is a key industry in the South, where it yields early returns from

land used for growing slash and longleaf pine trees. Two vital needs for its permanence and prosperity are lower costs of production through larger yields per tree and broader outlets for the products. The first calls for a better understanding of the processes of oleoresin formation in the tree, which involve the general processes of tree life and growth. During the year the chemical structures of the slash pine tannins in the phloem, or white inner bark, were determined. They were found to be of the same type as the coniferous wood tannins which are so troublesome in pulp bleaching. The new knowledge obtained will be of value in the further development of pine pulping processes as well as to the naval-stores industry. Along the second line, a comprehensive technological and economic survey of the naval-stores industry was carried out in cooperation with the forest survey. The principal conclusions were: (1) Turpentine cannot find adequate market as a paint thinner, but requires a lower price to find new industrial uses. (2) Gum rosin as now produced is not well-suited to modern industrial requirements, but holds its market because of low price; an improved product will enlarge its field and permit increased value to offset inevitable shrinkage in revenue from turpentine. (3) The potential world production of naval stores is now far beyond existing demand. Expanded markets will aid materially in stabilizing this important industry.

IMPROVEMENTS AND TRENDS IN THE USE OF WOOD

The chemical seasoning of wood continued to give phenomenal results in shortening the seasoning process and in reducing drying degrade. Among the new chemicals tried was invert sugar. It gave promise of being very helpful in the seasoning of special items, such as Douglas fir cross-arm stock, for which salt and other previously used chemicals are not entirely suitable. The time required to kiln-dry comparatively thick boards of such southern hardwoods as the gums, magnolia, hickory, and sycamore was reduced by means of chemical treatment to less than half that formerly required, and the wood has dried without defect.

The effectiveness of a new wood preservative can be known only through long tests in actual service. Many new proprietary preservatives are being pushed on claims based mainly on theoretical considerations. To test these new preservatives, many posts were treated and will be set in fences on the Harrison Experimental Forest in Mississippi.

Modern furniture, sash, and other woodworking plants use high-speed machines. It was found that the wood of many species, especially from southern hardwood stands, little used in the days of hand tools, and held relatively undesirable, have good machining qualities under modern methods. A booklet giving the results of this work to date was issued.

Extensive field studies were made in cooperation with the forest survey relative to the present and future lumber consumption at representative plants manufacturing automobile bodies, agricultural implements, refrigerators, furniture, and railway cars.

CHEMISTRY OF WOOD

The past uses of wood may be greatly extended when its fundamental chemistry becomes established. Wood is roughly two-thirds cellulose and most of the remaining one-third is lignin, with some extractives and a bit of ash. Cellulose is the material of which the wood fibers are composed, lignin the glue that holds the fibers together. Wood cellulose is extensively used, but lignin very little; millions of tons of it are dumped as waste into rivers and streams every year. Its extensive utilization, as well as an accurate technological analysis of wood, depends upon thorough knowledge of lignin chemistry. During the year considerable evidence was discovered indicating that lignin in solution is a homogeneous material each particle of which is an aggregate of four simpler chemical units. A new theory of the basic structure of lignin was developed, which departs radically from older conceptions. It holds lignin to be a furan derivative instead of a benzene derivative. Further work will be largely oriented by this theory.

Physicochemical studies of the shrinkage and swelling of wood continued to yield valuable information of practical application to wood preservation and seasoning. Measurements of the absorption of water from various aqueous solutions laid a better foundation for chemical seasoning, and developed the interesting fact that the attractive force of wood for water is approximately 25,000 atmospheres, or twice that of water for water. Antishrink efficiencies up to 70 percent, accompanied by increased strength and hardness, were obtained

by the formation of synthetic resins within the wood after impregnation with the raw materials of synthetic resin formation.

Encouraging results were obtained in the conversion of sawdust into durable, moldable, and machinable plastic that may find use as wallboard, floor tile, and other products, at a cost per square foot estimated to be equivalent to the general price level of lumber. An entirely new process of producing a wood plastic was discovered. It consists of hydrolyzing wood in the presence of aniline. The resulting yield is more than 90 percent of the original wood. The new plastic promises to be stronger and more resistant to water than any of the wood plastics previously produced.

PULP AND PAPER

In the pulp and paper investigations development of data bearing on the more effective use of southern and western woods was continued as a major objective. In the South, differences due to growth variations were found more important than differences between species of pine; in all four of the major southern pine species—loblolly, slash, longleaf, and shortleaf—the most important single factor in chemical pulping of the normal wood is the ratio of summerwood to springwood. The fiber characteristics of these two types of wood vary markedly, and in turn influence the processing required and the nature of the pulp produced. Previous observations of the adverse effect of heartwood in sulphite pulping were confirmed. In mechanical pulping it was discovered that a good quality of ground wood pulp can be obtained from wood containing a relatively high proportion of summerwood, if the latter is of rapid growth. Pine heartwood was not found to affect the strength of ground wood pulp. Deposition of pitch on the pulp- and paper-making equipment was noticeable only when processing the older and slower growing pine, whether or not heartwood was present, but pitch deposition was more accentuated if the wood contained heartwood. While the presence of heartwood in the slower growing wood also appreciably lowered the color quality of the ground wood, this fact, aside from trouble that might be encountered because of pitch, would not seem to detract from the use of the pulp in coarse papers and board products.

A most significant finding was the profound effect of compression wood and of the abnormal growth closely associated with compression wood on pulp quality, regardless of process. Compression wood not only differs from normal growth in chemical composition but is characterized by abnormal fiber properties that are reflected in weaker pulps, lower yields, and higher bleach requirements. Compression wood and associated defect is more prevalent at the butt cuts of rapidly growing pines, and is frequently, but not always, associated with eccentricity of growth. These facts may possibly be the basis for methods of selection.

Progress was made along several lines in the production of newsprint papers from southern pines. A semisulphite pulping process, developed at the Forest Products Laboratory several years ago, was successfully applied to loblolly pine, resulting in pulp yields of more than 60 percent as compared with 48 to 50 percent obtained by the standard sulphite method. The color and strength of this semisulphite pine pulp was satisfactory for newsprint, and papers were made in which the semisulphite pulp was wholly substituted for the ordinary sulphite component of newsprint.

Work on western species was continued, with pulping of silver fir by both the sulphite and the sulphate methods. The best strength and lowest bleach requirement for a kraft pulp was attained with liquor concentrations of approximately 50 grams per liter and indirect heating, the resultant pulp being equal to high-grade kraft pulp made from other species. Pulp obtained from the top portions of the tree had the highest value in bursting and folding strength, but pulps from the butt logs showed the best tearing quality. Silver fir pulped by the standard sulphite process gave high yields of pulp of excellent quality, characterized by high tearing strength, high porosity and absorbency, and a particularly good viscosity. These properties suggest its possible use in cellulose derivatives, such as rayon, as well as for paper manufacture.

In the field of paper making, studies on the markedly deleterious effects of small amounts of dissolved iron in water used in bleaching, beating, and on the paper machine were made. Small traces of iron in waters were found to lower the whiteness of bleached pulps as much as 10 percent. The improved experimental paper machine produced sheets of papers of commercial quality for the final evaluation of pulps and woods, and was used cooperatively by the industry for preliminary evaluation of new products and processes.

RELATED INVESTIGATIONS

The preceding condensed review of leading projects has passed over much of importance, some of which calls for brief mention.

A survey was made of existing timber resources in southern Wisconsin and an attempt made to predict the future trend of timber consumption there, so that the most suitable type of permanent industry for harvesting this forest crop can be established.

Approximately 900 resin cups made from waste pine and treated with various coatings for protection against weathering were hung in turpentine stands, to determine the serviceability of cups made of wood.

A new type of hygrometric moisture meter for the rapid determination of the quantity of moisture in wood was developed. The new meter, which will fall in a very low price class, is effective over a range of from 2- to 30-percent moisture content, and can be conveniently carried in a coat pocket.

A new design was evolved for a portable sawmill which promises more economical and efficient lumber production from farm woodlands and small timber holdings.

A type of kiln that promises to be helpful in extracting seed from the cones of forest trees to meet the present increased planting programs of Federal and State nurseries was designed; and a unit was placed in operation on the Ozark National Forest. The kiln, which follows rather closely the design of the internal-fan lumber kiln developed at the laboratory a number of years ago, will extract seed in less time than is required by most existing methods, and will yield more viable seeds per bushel of cones at a lower cost of seed per pound.

A start was made in the study of fiberboard for shipping containers, with the purpose of bringing to this material the benefits of economy in design and use that have so effectively lowered costs with wood construction. Economic trends presage the increasing importance of chemical and mechanical conversion products like fiberboard in the shipping container industry, with extended markets and uses.

FOREST ECONOMICS

Widespread public concern for the proper use of timber and forest-land resources, coupled with the growing interest of forest owners in the better management of their properties, is resulting in a steadily increasing demand for forest-economics information. Many timber operators who became interested in improved forest practices under the stimulus of the Lumber Industry Code of N. R. A. have continued their interest since the code was abandoned. To this sustained interest the numerous investigations of logging and manufacturing methods and costs conducted by the Forest Service have contributed materially. Particularly notable was a report (published with the cooperation of the Charles Lathrop Pack Forestry Foundation) on Selective Timber Management in the Douglas Fir Region.

This report analyzes the economic aspects and the feasibility of applying intensive methods of operation under conditions heretofore believed prohibitive of any method other than the traditional large-scale clear-cutting. The principles and methods developed may have a profound effect on both private- and public-forest management. A study with somewhat similar objectives, but dealing with very different forest and operating conditions, was made on a number of typical operations in the ponderosa pine section of eastern Oregon. Here also the results point toward fundamental changes in methods of management, under which heavy cuts at long intervals will be replaced by light, frequent cuts, with greater profit to the operator and greater stability for the operation and the dependent communities.

Studies in virgin and second-growth stands of shortleaf and loblolly pine in Arkansas demonstrated the practicability of making very light cuts at short intervals, thus building up and maintaining an adequate stock of growing timber and permitting the production of a much higher grade of timber than would be economically possible under the old clear-cutting methods. The method has already been adopted by several operators. Other production-cost investigations dealt with the utilization of worked-out turpentine trees for pulpwood, barrel staves, and lumber in Florida and Alabama. It was found that longleaf pine trees not turpentine before they reach 11 inches in diameter can be worked 50 percent longer, give larger yields, and are worth more for lumber or other products after they have been worked than are 9-inch trees.

In California, cooperative studies of logging and milling were continued in the pine belt; and in the Northeast studies were conducted at representative second-growth white-pine operations in Maine, Massachusetts, and New Hampshire and at northern-hardwood operations in New Hampshire, Vermont, and New York. The cost of producing pulpwood on northern New Hampshire farms was studied in cooperation with the Rural Resettlement Administration.

A further study of forest-land ownership, with particular reference to tax delinquency and the relation between delinquency and type of cover and character of ownership, was made in the Douglas fir region, in cooperation with local agencies. In California the study of land use in five counties in the Sierra foothills was continued, with the cooperation of the Giannini Foundation. Here the Forest Service is particularly interested in the possibility of stabilizing local communities partly dependent on the adjoining public- and private-forest resources, and in working out a stable coordinated form of use for the foothill lands that are or should be devoted to forestry. Problems of public finance and governmental organization as well as of local resource utilization are involved. A report on this project was completed, and a somewhat similar study of the relation of taxation and public finance to land use in four counties of the south-central Sierras was initiated.

Records of ownership and tax delinquency were collected in connection with the forest-survey inventory in Michigan and will be used in analyzing the effect on delinquency of physical characteristics of the forest land. A survey of forest-land ownership, taxation, and delinquency in southeastern Georgia and northeastern Florida was completed, and reports were published on the Extent of Tax Default in the Gulf States in 1934 and Use of Land for Forests in the Lower Piedmont Region of Georgia.

Forest-insurance investigations included a survey of fire hazard in the naval stores belt of the Southeast (in cooperation with the Farm Credit Administration), appraisal of damage on burned areas in northern New England, and collection of fire records for a 10-year period in New York and Pennsylvania.

To develop the possibilities of better management of farm woodlands, coordinated in such a manner as to insure continuous supplies of timber for local industries, a project for cooperative farm-woodland management and marketing is being studied near Cooperstown, N. Y., jointly with the New York State College of Forestry. An important problem here is the building up of an adequate growing stock in place of the present seriously depleted second-growth stands, by making very light but frequent cuts that take the inferior trees and leave the best ones to grow. This introduces difficult economic questions in the field of production costs and marketing.

In continuing cooperation with the Bureau of the Census, the usual canvass of lumber and timber products was conducted in the 12 Western States. Statistics of lumber distribution and consumption for 1934 were compiled and published. The 1934 stumpage and log prices were published in the form of a statistical bulletin, and 1935 prices were compiled for all forest regions. Considerable progress was made on the preparation of a comprehensive bulletin on stumpage prices for the period 1900 to 1934, inclusive.

FOREST SURVEY

With the help of emergency funds, substantial progress was made on the forest survey. In the Pacific Northwest the field work has now been completed except for about 6,000,000 acres of northeastern Oregon, and the data have been compiled for all of the area west of the Cascades and about half of that on the east side. Forest-type maps for the western portions of Oregon and Washington were lithographed, and about 1,500 copies were distributed to a wide variety of agencies. Maps of the remaining portions, except one Oregon map, are in process of publication. Preliminary reports of the survey units west of the Cascades were written, and work was initiated on the comprehensive regional report. A compilation, Pulpwood Resources of the Douglas Fir Region, was printed and distributed. A special report was prepared for the Army Engineers on the supplies of pulpwood potentially available within the territory tributary to the Bonneville Dam.

In California field mapping has now covered 50 percent of the area and office compilation close to 25 percent. Plans were made for commencing the timber-inventory phase of the survey. In the northern Rocky Mountain region mapping has now covered 96 percent of the forest land of northern Idaho, all of northeastern Washington, and 27 percent of western Montana, or slightly more than 16,000,000 acres. Data on timber stands have been collected for

almost 29,000,000 acres. A survey of depletion by cutting has been completed and a report prepared, and considerable work has been done on a survey of urban, rural, and industrial (mines and utilities) requirements for timber and fuel wood.

Field work for Minnesota and Michigan has been completed, and part of Wisconsin has been covered. Office compilation is well up with the field surveys. Studies of depletion and consumption have been completed for Minnesota, nearly so for Michigan, and are well under way for Wisconsin. Several reports on the resource phase of the survey were issued.

In the South field surveys have covered about 129,000,000 acres of forest land, leaving only about 11,000,000 acres in Oklahoma and Texas still to be surveyed. Compilation of data has made good progress though it has not been possible to keep pace with the field work. Several reports on potential pulp-wood supplies were issued.

Investigations of normal lumber requirements for farm construction were completed for all States. These indicate that the present increasing demand will run for several years. A similar situation is indicated in regard to residential construction. Studies were also completed of trends in consumption of naval stores and timber for hardwood distillation. The most important conclusion as to the distillation industry is that new markets for charcoal are needed if the industry is to grow.

FOREST TAXATION

The taxation staff has continued its activities looking toward the application of principles and methods developed in its major investigation of forest taxation. In response to requests, it has made local studies in several States for the purpose of giving advice on this subject. It has also undertaken a study of the fiscal relations between the Federal and local governments growing out of the nontaxable status of national forests and existing Federal contributions in lieu of taxes.

FOREST AND RANGE INFLUENCES

Forest-influence experiments and studies, begun soon after the Forest Service was organized, have in recent years been piling up a mountain of evidence on the importance of an adequate cover on lands not needed for agriculture. At the request of the House Committee on Flood Control, in connection with hearings on H. R. 12517, the results of this forest-influence work were summarized and a national program of action for forest lands was recommended. This material was published by the Committee under the title "Forests in Flood Control."

One of the most striking examples of the influence of forest cover was obtained by the Appalachian station. Records of the continuous flow of streams from 23 small watersheds, representing different types of forest and other vegetative cover, show that during the 12-month period July 1, 1934, to June 30, 1935, the average maximum flood flow for all the forested watersheds amounted to only 38 cubic feet per second per square mile; for grassed and abandoned agricultural lands, 432 cubic feet per second per square mile; for completely denuded land, 1,304 cubic feet per second per square mile. In no case did the storm run-off from forested watersheds assume critical flood conditions, whereas numerous instances were recorded in which the maximum flow from the nonforested watersheds assumed very serious flood proportions.

At the Upper Mississippi Erosion Station at La Crosse, Wis., maintained in cooperation with the Soil Conservation Service and the University of Wisconsin, somewhat similar studies demonstrated the comparative watershed protection value of cleared pastures, pastured wood lots, and ungrazed wood lots. Of the total rainfall occurring during the period May to November, the recently cleared pasture yielded 3 percent in the form of surface run-off; the pastured wood lot about 9 percent surface run-off; while the ungrazed wood lot yielded only 0.15 percent in surface run-off. The total amount of soil washed away during the same period amounted to 600 pounds per acre for the cleared pasture, 1,600 pounds per acre for the pastured wood lot, but only 17 pounds per acre for the ungrazed wood lot. The ungrazed timbered watershed demonstrated its ability to absorb completely precipitations in individual storms ranging from $\frac{3}{4}$ to 2 inches.

The Intermountain Forest and Range Experiment Station determined that the small mountain creeks between Farmington and Centerville in Davis

County, Utah, seldom flow more than one-half second-foot during the critical water periods of July and August, yet the value of this water may be as high as \$50,000 from a single canyon with a drainage area of only 1,500 to 2,000 acres. The value of the stream flow per acre of watershed above 7,000 feet in elevation varies from approximately \$13 (Davis Creek) to \$104 (Centerville Creek), with an average value of about \$39 per acre.

Terrace-trench erosion control, followed by restoration of the plant cover, applied to 500 "key" acres of seriously eroding lands in Davis County, Utah, has practically eliminated the menace of floods from 8,500 acres of watershed. This control work cost from \$25 to \$75 per acre, exclusive of reseeding and planting; it is justified only where dependent values are high.

Tests at the Boise Basin Experimental Forest in southwestern Idaho with a portable apparatus for measuring the rate of surface water penetration into soils demonstrated that fibrous-rooted plants are about two and one-half times as effective in increasing absorption as are the taprooted species. Plots supporting fibrous-rooted plants absorbed water 0.0453 inch per minute faster than did corresponding barren plots, an increase of 127 percent; plots supporting taprooted species, only 0.0206 inch per minute faster, or an increase of only 51.5 percent. Since most of the better range forage plants are fibrous-rooted species, both grazing and irrigation interests would seemingly profit through the development and maintenance of good stands of fibrous-rooted, highly palatable plant cover on range watershed areas.

Measurements of evaporation and transpiration by the Southwestern Forest and Range Experiment Station showed significant results. At the Parker Creek Experimental Forest in central Arizona, block samples of clay gravel soils were used to determine how much water was used by plants of the semidesert watersheds. The combined evaporation-transpiration loss from soils supporting plant growth was only 10.5 percent greater than evaporation alone from bare ground, indicating that range watershed protection is possible on at least some types with little sacrifice of water.

EXPENDITURES AND RECEIPTS

The expenditures during the fiscal year were as follows:

General administration-----		\$924, 014. 28
Administration, protection, improvement, reforestation, and extension of national forests:		
Operating expenditures:		
Timber use-----	\$1, 009, 882. 08	
Grazing use-----	920, 511. 75	
Recreation and land use-----	709, 067. 49	
Fish and game protection-----	564, 561. 04	
Classification, settlement, and claims-----	137, 132. 03	
Maintenance of truck and horse trails-----	3, 148, 372. 00	
Maintenance of other improve- ments-----	1, 416, 948. 25	
Subtotal-----		\$7, 906, 474. 64
Protection expenditures:		
Fire prevention and detection--	\$3, 585, 819. 99	
Fire suppression-----	1, 101, 452. 09	
Class total (fire)-----	4, 687, 272. 08	
Protection against insects and tree diseases-----	101, 714. 85	
Subtotal-----		4, 788, 986. 93
Investment expenditures:		
Construction of truck and horse trails-----	\$16, 072, 004. 76	
Construction of other improve- ments-----	8, 170, 433. 06	
Equipment and stores-----	10, 938, 730. 53	
Timber surveys and plans-----	485, 255. 69	
Grazing surveys and plans-----	125, 693. 57	
Fish and game surveys and plans--	306, 324. 67	
Recreational-use surveys and plans-----	299, 250. 10	
General surveys and plans-----	474, 408. 24	
Timber-stand improvement-----	938, 861. 70	
Reforestation of denuded areas--	1, 213, 584. 02	
Nurseries and planting stock----	385, 461. 69	

Administration, etc.—Continued.

Investment expenditures—Continued.

Acquisition of land by direct purchase ----- \$16,615,782.74

Acquisition of land by exchange ----- 1,265,394.37

Nonstructural improvements (erosion, tree-disease, and insect control, fire-hazard reduction, and miscellaneous investments not otherwise classified) ----- 2,766,076.27

Subtotal ----- \$59,057,261.41

Construction and maintenance of forest highways:

Construction of forest highways ----- \$9,803,946.63

Maintenance of forest highways ----- 884,783.10

Subtotal ----- 10,688,729.73

Total, national forests ----- \$82,441,452.71

Plains shelterbelt project (including nurseries):

Current expenditures:

General administration ----- \$124,884.89

Maintenance of improvements ----- 111,485.17

Subtotal ----- \$236,370.06

Investment expenditures:

Construction of improvements ----- \$161,296.79

Equipment and stores ----- 95,401.76

General surveys and plans ----- 187.23

Grazing surveys and plans ----- 4,291.67

Reforestation of denuded areas ----- 765,049.21

Nurseries and planting stock ----- 320,614.34

Nonstructural improvements (erosion, tree-disease, and insect control, fire-hazard reduction, and miscellaneous investments not otherwise classified) ----- 19,624.98

Subtotal ----- 1,366,465.98

Total, Plains shelterbelt project -----

1,602,836.04

Research:

Research current expenditures:

Forest management ----- \$896,943.32

Range investigations ----- 309,489.51

Forest products ----- 778,881.58

Forest survey ----- 701,745.63

Forest economics ----- 140,453.27

Erosion and stream flow ----- 299,718.55

Forest taxation and insurance ----- 15,113.33

Maintenance of roads and trails ----- 19,232.64

Maintenance of other improvements ----- 63,587.63

Fire prevention and detection on experimental areas ----- 1,368.30

Subtotal ----- ²\$3,226,533.76

Research investments:

Construction of roads and trails ----- 34,321.80

Construction of other improvements ----- 381,706.22

Equipment and stores ----- 216,044.35

Timber surveys and plans, experimental areas ----- 2,842.57

General surveys and plans, experimental areas ----- 95,783.50

Timber-stand improvement, experimental areas ----- 109.87

Nonstructural improvements on experimental areas (erosion, tree-disease, and insect control, fire-hazard reduction, and miscellaneous investments not otherwise classified) ----- 156,182.76

Subtotal ----- 886,991.07

Total ----- 4,113,524.83

¹In addition to the expenditure for acquisition of land by exchange, national-forest timber having an estimated value of \$470,585.00 was cut under agreements involving the acquisition of land and timber through exchange. The cash expenditures recorded opposite "Acquisition of land by exchange" cover merely the outlay incidental to examining lands offered for exchange and appraising the value involved.

²Includes \$72,151.75 expended from Plains shelterbelt project funds.

Protection and reforestation of other than national-forest lands:

Tree planting in cooperation with States and others.....	\$91, 387. 26
Fire protection in cooperation with States and others.....	1, 818, 209. 92
Protection of Oregon and California grant lands.....	82, 765. 98
Extension of forestry practice on State and private lands.....	610, 295. 27

Total..... \$2, 602, 658. 43

Emergency Conservation Work on other than national-forest lands:

State and private camp expenditures.....	\$23, 081, 514. 10
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Total..... 23, 081, 514. 10

Miscellaneous:

Emergency unemployment relief; cooperation with other agencies in connection with Emergency Conservation Work for which these agencies are responsible.....	\$608, 077. 81
Emergency unemployment relief; Federal Emergency Relief Administration, etc.....	326, 702. 06
Tennessee Valley Authority; Emergency Conservation Work.....	671, 739. 40
Insular Forests, Puerto Rico; Emergency Conservation Work.....	425, 167. 09
Examination and administration of power sites for Federal Power Commission.....	15, 889. 68
Miscellaneous cooperation with other departments, bureaus, and individuals.....	1, 062, 921. 16

Total..... 3, 110, 497. 20

Grand total..... 117, 876, 497. 59

The above expenditures were authorized by diverse acts of Congress, some directly appropriating funds for the Forest Service, some placing funds initially at the disposal of other agencies. Each appropriation item and each allocation of funds is necessarily handled as a separate account, to assure that all disbursements are made in accordance with the law governing the use of the particular fund drawn upon. The space limitations of this report prevent a full showing of the legislative source of each fund and of the legislative authority to make the expenditures shown, for the purposes shown. All that can be done here is to list the expenditures of the year, from the standpoint of source, under the abbreviated captions used within the Forest Service to distinguish the individual accounts. To those familiar with the work of the service these captions will be in varying degree self-explanatory.

Salaries, office of Secretary of Agriculture.....	\$28, 099. 35
Salaries and expense, District of Columbia.....	358, 275. 87
Salaries and expense, regional (protection and administration).....	8, 004, 821. 23
Fire fighting.....	1, 387, 080. 78
Forest products.....	507, 293. 60
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Acquisition-----	10,504,972.09
Other-----	1,726,926.94
States-----	928,243.95
Loans and relief in stricken agricultural areas, act June 19, 1934----	102,766.77
Acquisition funds, regular (to correct previous years)-----	350,307.71
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Forest highways-----	4,036,476.89
Forest-road development-----	27,461.63
Roads and trails for States (10 percent)-----	13,003.13
Cooperative work, Forest Service-----	149,838.06
Undeposited cooperation-----	185,990.08
N. I. R. A., highways-----	1,439,195.92
Emergency highways act June 19, 1934-----	3,541,068.77
N. I. R. A., development-----	79,843.08
Emergency development roads, act June 19, 1934-----	104,157.17
Total-----	117,876,497.59

Summary of expenditures by appropriations:

Regular annual appropriations-----	\$12,654,941.16
Regular continuing appropriations-----	6,479,330.43
Cooperation (deposited, undeposited, repayments, etc.)-----	1,844,066.71
Emergency appropriations (Emergency Conservation Work on other than national-forest lands)-----	22,224,283.11
Emergency appropriations (all other)-----	61,616,499.90
1936 expenditures from 1935 emergency appropriations (obligated in 1935 but not previously reported as expenditures)-----	13,057,376.26
Total-----	117,876,497.59

The following statement shows the gross and net cash receipts from the national forests:

Gross receipts from national forests:	
From the use of timber-----	\$2,203,237.06
From the use of forage-----	1,441,493.23
From special land uses, water power, etc-----	418,232.89
Total receipts-----	4,062,963.18
Less payments to States:	
To Arizona and New Mexico, account school lands administered by Forest Service-----	31,685.48
To States in which national forests are located under act of May 23, 1908-----	1,995,890.71
Total to States-----	1,027,576.19
Net total receipts to United States Treasury-----	3,035,386.99

¹ Computed on basis of total receipts less (a) payments to Arizona and New Mexico on account of school lands administered by Forest Service, and (b) receipts from Uinta and Wasatch National Forests for period Sept. 1, 1935, to June 30, 1936, appropriated in the Appropriation Act for Department of Agriculture, fiscal year 1936, for acquisition of lands and authorized by act of Aug. 26, 1935 (49 Stat. 866), \$47,714.85.

The total of the gross is greater by \$771,651.34 than that for the previous year. Receipts from timber increased \$471,882.01, grazing increased \$290,340.30 and miscellaneous receipts increased \$9,429.03.

In addition to the cash receipts from timber, there should be credited the value of the timber cut under specific agreements for effecting land exchanges, estimated at \$470,585.

REPORT
OF THE CHIEF
OF THE
FOREST SERVICE

1937



Report of the Chief of the Forest Service 1937

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,

Washington, D. C., September 15, 1937.

HON. HENRY A. WALLACE,
Secretary of Agriculture.

DEAR MR. SECRETARY: Few people realize that one-third of our continental land area is forest land and that it is most valuable for forest purposes.

Too few realize that 6 million people get their daily bread from industries dependent on forest resources; that farm wood lots make up more than 17 percent of all farm lands, and help support 2½ million farmers; that forest lands also provide work for millions of people who otherwise might not have been employed; that this work is worth while, noncompetitive with industry; that possibilities for it are well-nigh unlimited.

There is too little realization that forest lands influence farming operations generally; that these lands help protect watersheds, prevent soil erosion, and silting of reservoirs; that they store and regulate domestic and irrigating water.

Recent extensive industrial pulp and paper developments in the South furnish added proof of the many social and economic significances of forest lands. As you know, I am greatly concerned over the South's present situation, and have sounded a warning about the danger of widespread forest exploitation there.

I have felt impelled in this year's report, transmitted herewith, to bring into sharp focus the seriousness and significance of our forest situation, some of the things already done to help meet it, and certain outstanding things still to be done if we are to avoid repetition of social and economic tragedies like those which have been widespread in forest regions generally.

Public ownership and management are established but must be increased. Public responsibility for help in research, and protecting private forest lands from things like fire and disease is clear, and public assistance must be continued. Voluntary action by private owners of forest lands must be encouraged. But these things are not enough. Neither in this country nor in any other have they brought sustained-yield forest management, with security for labor and industry, generally. Instead, public regulation in some form has invariably been necessary. Let's face this fact.

Sincerely,



Chief.

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Our Forest Lands

1. An economy of scarcity with respect to forests is unsafe. Lumber is but one product of wood, an abundant source of cellulose, lignin, turpentine, drugs, chemicals. It makes paper, rayon, plastics, films, explosives, lacquers, dyestuffs, alcohols, acids, gas for automobiles, food for cattle. It can make artificial wool, adhesives, human food in certain forms. What it may make depends largely on research, invention, development. Synthetic rubber, from by-products of wood, is chemically possible.

2. All forest lands now total 615 million acres—almost one-third the continental United States. Of these—

(a) More than 70 percent is privately owned.

(b) Less than 30 percent is publicly owned.

3. Forest lands now noncommercial—poor, rough, at present inaccessible—total 120 million acres. Of these—

(a) Only four-tenths is privately owned.

(b) Six-tenths is publicly owned.

4. Commercial forest lands—capable of growing marketable timber—total 495 million acres. Of these—

(a) The best four-fifths is privately owned.

(b) Only the poorest one-fifth is publicly owned.

5. Commercial saw timber, originally 5,200 billion feet, is now only 1,668 billion. Of it—

(a) The best three-fifths is privately owned.

(b) The poorest two-fifths is publicly owned.

6. Of all potential forest growth—

(a) Some nine-tenths is on privately owned lands.

(b) About one-tenth is on publicly owned lands.

7. Of all forest products—

(a) Ninety-eight percent is cut from privately owned lands.

(b) Only 2 percent is cut from public lands.

8. Though the difference is not now so great, for 1925 to 1929, inclusive, forest drain exceeded forest growth by—

(a) About 2 to 1 in all sizes, but

(b) About 5 to 1 in saw-timber sizes.

9. Of forest area needing it, adequate fire protection is still lacking on—

(a) Some forty-five percent of all privately owned forest lands.

(b) Less than 5 percent of all public forest lands.

10. Even recently, forest fires still burn, each year—
 (a) Forty-odd million acres in private ownership.
 (b) Less than one-half million acres in public ownership.
11. Forest industries support 6 million people each year, and wood lots help support $2\frac{1}{2}$ million farmers. Yet—
 (a) More than 380 million acres privately owned are still without forest management, while
 (b) Less than 15 million acres—State lands, Federal public domain, etc.—are now without forest management.
12. Private ownership holds the key to our forest situation. With minor exceptions, forest exploitation continues there.

A Three-Point Program

1. Public ownership and management have established conservation on the publicly owned national forests. In 38 States, they help protect watersheds and feed livestock and wildlife. They afford recreation to more than 30 million people each year and help support nearly a million. Ratio of private to public ownership is now more than 2 to 1. In general, acreage in public ownership should be the greater.

2. Public cooperation with private owners.—State cooperation has been outstanding. Federal appropriations plus Civilian Conservation Corps work already total $82\frac{1}{2}$ million dollars. Public obligations and responsibilities are recognized through coordinated State and Federal action in research and such things as protection from fire, insects, and diseases. This should be continued. With safeguards to insure adequate participation by private owners, it should be extended.

3. Public regulation—as a margin of sovereignty over private forest lands—is also essential. It will protect broad, vital public interests. Private owners who recognize social obligations inherent in forest-land management will also be protected, by such regulation, from owners who otherwise might continue ruthless exploitation.

Forest and Human Conservation

Human welfare, a fundamental objective of conservation, depends on wise use of natural resources. We cannot conserve merely by preserving. The good earth offers its soils and its waters. They yield plant and animal life. But we destroy unless replenishment goes hand in hand with use.

Forests are vital tools in the service of mankind. They retard too rapid run-off; help control erosion and floods; conserve soil and moisture. Power from water is the backbone of many industries. More than 2 billion gallons of water are consumed daily by urban centers from Boston to Baltimore. Water from forested slopes is the lifeblood of many cultivated crops. Most of the habitat of our remaining big game is now on forest lands, and much feed for domestic stock. As sources for inspiration, forests foster spiritual and cultural values. Forest recreation totals some 250 million man-days each year.

Exponents of compound interest as a means to huge fortunes say we may have too much timber. Yet in addition to services already mentioned, forests give us building materials and fuel, alcohols, rayons, sugars, naval stores, combs, perfumes, phonograph records, surgical absorbents, newsprint, fiber containers, and thousands of other products in everyday use. Forests occupy more acres than any other crop on American farms; farm woodlands furnish posts, fuel, and supplemental cash incomes to 2½ million farmers annually. And nearly 6 million of our people are directly supported by workers normally employed in lumber, pulp and paper, and other forest industries.

Exploited and mined, forests disappear and communities and families are often left destitute and forlorn. Seven thousand woodsmen once worked out of one prosperous Lake State town. After forests were gone its population dropped to 300. Tar-paper shacks and rusty tin cans have replaced attractive homes and geranium beds in hundreds of communities where forests once seemed inexhaustible. Yet as living resources under planned management those forests could have been renewed and maintained; could have helped stabilize industries and communities and maintain them permanently.

With minor exceptions, our remaining forest lands are most valuable for purposes like those mentioned. They total 615 million acres; about one-third of our continental land area. Noncommercial forest lands are rough and nonagricultural. They occupy 120 million acres, with 48 million in private and 72 million in public ownership. Commercial forest lands total 495 million acres, but under present conditions only about half the timber on them can be logged at a profit. Of this 495 million acres 80 percent is in private, and the poorest 20 percent is in public, ownership.

Forests are instruments for human welfare. The manner in which forest lands are handled is vital to our social and economic structure. Many people think conservation concerns trees alone, but public policy does not. Nor does it consider trees as an end in themselves. Treating

forests as crops it holds that, through use, their true function is to add to man's welfare. Applying this basic principle to all resources of forest lands and to all services they perform, forest conservation helps in many ways to conserve human resources.

PUBLIC FORESTS

With this in mind Congress authorized the national-forest system in 1891. The first Federal units were remnants of public domain, which was in the West. Before long New England and the South needed help. In 1911 the Federal Government was authorized to purchase forest lands. In 1924 the scope of this act was enlarged.

As a State activity forestry in some form began in California, New York, Ohio, and Colorado in 1885. In addition to parks, 36 States now have State forests. Most of them are managed with reference to future timber production as well as for recreation. State forests now total 8,399,456 acres, with about 75 percent in Pennsylvania, Minnesota, and Michigan. As of June 30, 1937, 36 States had met requirements of the Fulmer Act, which authorizes the Federal Government to cooperate in promoting State forests. When funds can be made available, these States are in position to take immediate advantage of that legislation.

Most public forest land is now in national parks, monuments, and national forests. The two former include some 17 million acres, not all of which is forested; are administered by the National Park Service of the Department of the Interior. Park resources are rightfully preserved rather than harvested; inspiration and recreation reign supreme. National forests, administered by the Forest Service, include areas where timber is sold to commercial concerns and—within reasonable limits—is free to local settlers for home use. Watersheds are protected as mature trees are harvested, stands of second-growth improved, young trees planted. There are also national-forest areas where no timber may be cut and where primitive conditions are maintained.

Half the population of Flagstaff, Ariz., depends directly or indirectly on forest products from the Coconino National Forest. Coming as they do from every State, thirty-odd-million vacationists find health and happiness on national forests each year, and spend money locally that in the aggregate totals a huge sum. In certain Montana counties a 55-million-dollar investment and the livelihood of more than 5,000 people depend largely on planned and regulated use of national forest forage. Ponderosa pine on the Harney Forest in South Dakota is relatively poor, yet through small portable sawmills it contributes 20,000 man-days of work to local families year after year.

These are examples of communities and regions where jobs are steadier, industry and agriculture more secure, the flow of out-bound freight and in-bound merchandise evened because, instead of being exploited, forest-land resources are renewed and maintained through use. In such ways the national-forest system helps bring security to almost a million people who live in and near it. All national-forest resources are administered by a single agency. This has made for coordinated and correlated management; avoided unnecessary expense. It has also eliminated that confusion inevitable if more than one public agency had handled different activities on the same area. As public properties, national forests typify conservation through multiple-use; for more than 30 years they have helped promote human welfare nationally.

PRIVATE FOREST LANDS

National forests now embrace 172,652,201 acres net. In many countries this would be an empire, but private ownership holds the key to the manner in which by far the largest part of our forest lands are handled. It has the best four-fifths of all commercial forest land, almost three-fifths of the saw timber, at least nine-tenths of all potential forest growing capacity. Some 98 percent of our forest products still come from private lands, and drain is heavy there. In important saw-timber sizes it was about five times normal forest growth from 1925 to 1929. Stacked 4 feet high and 4 feet wide the yearly woodpile that goes to make up newsprint alone—and only that which comes from our own forests—would reach from Washington, D. C., almost to San Francisco, Calif. For all timber the drain, enough to surface a highway 80 feet wide from the earth to the moon with 2-inch planks, was about twice all forest growth.

As raw material, forests furnish employment for labor and provide business for industries. Properly managed, forests increase, as money does in a sound bank. If the owner—of money in bank or raw material in forest—uses only this annual interest, or growth, his capital remains unimpaired and brings added security and permanence to him and to labor. Yet under private ownership exploitation is still practiced generally; in many forest-dependent communities jobs, industries, and local agriculture are still insecure.

Forests also help protect soil and conserve and regulate water. About 40 million acres of our remaining forest lands bear on water problems generally. Another 300 million acres exert a major influence on important streams. The Ohio watershed was once 98 percent forested. More than 17,600,000 people live there today. On rough lands unsuited to agriculture, only about one-third of its drainage bears forests now. Under private ownership they have been heavily cut, repeatedly burned, and overgrazed. The Ohio has had many floods in the past. Records show that they are increasing in numbers and height of their crests. The 1937 flood, its worst, affected fine farms and industrial cities in 243 counties in 10 States. More than 640,000 people had to flee for their lives. Financial losses were enormous.

As immediate defenses against floods, people in river valleys must rely on downstream dams and reservoirs and levees built by an efficient corps of Army engineers. Yet the watershed also plays a vital part in any program of flood control. The Ohio drainage is one of many examples of the intimate relationships that exist between soil, water, and forests. Forests there, as elsewhere, render public services that may be greater even than those they have as producers of cellulose, or as property used or private gain.

CONSERVATION'S YOUTH

Conservation—of a sort—is older in the United States than our Constitution. The "broad arrow" marked trees reserved by the Crown to help relieve "the great and pitiful waste" of Britain's native woods. With the ax on tea, it contributed to the Revolution. Yet in 1779 Congress appropriated funds to purchase lands growing timber suitable for naval purposes. Reservations of public-domain timberlands were made in 1820. Forest protection was recognized as a Federal function when in 1822 the

naval brig *Spark* was ordered to prevent timber thefts along the coast of Florida and Louisiana. In 1828 forest planting was authorized.

These early efforts at forest conservation were ineffective. History records continued thefts of timber "cut to mold at the stump * * * in the form of stem posts, heart hooks, and knees." As the westward trek reached Lake States pine, a reputable Chicago newspaper counseled force to prevent Government agents from interfering with private initiative in public timber, and Federal agents lost their lives under suspicious circumstances.

As iron and steel replaced oak for warships, early forest reservations were canceled. Yet timber looting continued, and laws literally forced public-domain forest lands into private ownership. The intent was to favor the settler; to build up a democracy of small owners. But this was frustrated. The best commercially valuable forest was soon in the hands of a few individuals. Exploitation followed, and when skinned and denuded forest lands could not be sold, millions of acres went back, tax-delinquent, to form a new but well-nigh worthless no man's land.

A FOREST PROGRAM

In certain countries many forest lands have for centuries ranked high as sources for stable employment. Integrated with agriculture, they have been a backlog for a sound and enduring economy. Forests have been logged, but the power of the land to produce has been held inviolate. Annual growth has been harvested, but capital has been maintained. These forests yielded steady profits even during the late depression. Forest as well as political and economic conditions in Europe are of course different from those in the United States. And we don't want to transfer old-world conditions to the new, for we are proud of institutions and practices we have developed. Yet here, as elsewhere, there is a definite public interest that extends to all forest lands, no matter who owns them.

PUBLIC OWNERSHIP

In 1891 Congress authorized public ownership and management as one essential to an adequate forest program for our Nation. This was a departure from the traditional policy of private ownership, but within certain limitations it has demonstrated what forest conservation through planned use can do for people in communities and regions.

As a policy, public ownership and management of forest lands is based on the fundamental principle that Government must step in when, under private ownership, vital common interests are not adequately safeguarded. The many vicissitudes and aftermaths that have on the whole attended private ownership and operation of forest lands in the United States are cause for national concern. Public welfare demands that these conditions be replaced by such stability and continuity as will strengthen rather than weaken the social and economic structure.

To June 30, 1937, the National Forest Reservation Commission has authorized purchase of forest lands aggregating some 15,998,577 acres in 31 States, largely east of the Mississippi River. Some 16,131,460 acres have actually been purchased or are under contract. Twenty-four percent of these purchased lands now bears merchantable timber. Fifty-three percent bears young growth rapidly approaching merchantable sizes. On another 10 percent natural reproduction may, with adequate

protection, be expected to establish itself. On the remaining 13 percent, artificial reforestation will probably be required.

Outside already established national-forest purchase units there are 125 to 150 million acres now so badly depleted or so unattractive to private enterprise that public ownership seems essential to forest restoration and human welfare. Largely in the eastern United States, some 50 million of these acres probably can best be owned and managed by State and local public agencies, the balance by the Federal Government. Another twenty-odd million acres, largely mature timber in or near western national forests, should also be in Federal ownership in the interests of effective, coordinated, and economical administration and to help existing communities now threatened by early timber exhaustion. This program would leave some 270 million acres, largely the best commercial forest lands, in private ownership.

PUBLIC COOPERATION

Congress has set up cooperation—including Federal funds—as a method of helping private owners establish on their lands those forest practices so necessary to the public welfare.

As a second step toward a sound forest program for the Nation, public cooperation with private owners now takes many forms. Research helps eliminate or overcome economic handicaps and lay foundations for productive use of forest and range lands in private, State, and Federal ownership. To help industrial and other owners put their forest lands in better shape, and to help improve conditions in dependent communities, Divisions of State and Private Forestry have been established in the Forest Service. Benefit payments are now available in many States for tree planting and satisfactory timber stand improvement work applied to farm woodlands. More than 2,600 miles of shelterbelts and nearly 6,500 acres of farmstead plantings have been established as a cooperative emergency project. Our forests furnish some three-fifths of the world's naval stores. The Agricultural Adjustment Administration's naval stores conservation program, administered by the Forest Service, encourages conservative chipping, better fire protection, and use of a larger diameter limit for trees bearing one and two operating faces; providing better yields and helping conserve forest-land resources.

In Oregon and Washington 50 Forest Service representatives serve on regional, State, and county boards and help plan for better forest-land use. Unreverted regular and emergency appropriations for Federal acquisition of forest lands total, to June 30, 1937, some 76 million dollars, but regular appropriations for Federal cooperative work with farm and industrial owners of forest lands—plus replacement value of fire prevention and suppression work done on private forest lands under emergency allotments by the C. C. C.—total almost 82½ million dollars.

With public cooperation more forest lands now receive better fire protection, although not so long ago fire on private forest land burned each year an empire greater than all of Maryland, Connecticut, Massachusetts, Rhode Island, New Jersey, and New Hampshire combined. Applying some basic techniques and practices developed and applied on national forests for more than 30 years, more private owners now leave more cut-over forest lands in a more productive condition. And here and there farm woodlands, and occasionally industrial properties, are now managed on a sustained-yield basis. But these are exceptions. On privately owned forest land generally, exploitation still continues.

PUBLIC REGULATION

Forests were once treated as a public menace. It is useless to blame our ancestors, for they had troubles of their own. But our troubles are different, and so are our conditions. We no longer have hostile redskins behind every tree. Population in New York City is now three times what it was in 1770 in the 13 original Colonies. In terms of area, commercial forests have shrunk enormously. Soil, a basic resource, is now carried across half a continent by flood-swollen streams and dust-laden winds. Valleys and once-wooded slopes of the upper Missouri can never again support an aggregation of wildlife that in pioneer days exceeded anything man had ever seen. Remaining forest lands in the Ohio and other great drainages, overcut and overgrazed, can no longer function as they should. Damage from floods and erosion to farms and industrial centers is increasing. As crops, forests can be harvested and renewed, yet on land in private ownership they are in general still exploited.

Public ownership of forest lands is essential to a sound national program of forest and human conservation. So is public cooperation with private owners. The present ratio of private to public ownership is more than 2 to 1. Acreage in public ownership should be greater than in private ownership. With safeguards to insure more adequate participation by farm and industrial owners, public cooperation with them should be continued.

But current conditions raise the question whether public ownership, and public cooperation, are adequate to meet the existing situation. With the many broad interests at stake, and with a crop that matures as slowly as timber does, a margin of sovereignty over private forest lands is also necessary. This sovereignty can successfully be exercised only by government, in which it is lodged.

Post-mortems will not, of themselves, prevent wrecked forest lands, stranded communities, eroded farms, flooded cities. For the national good, positive measures are necessary. Except in individual cases—and they are pitifully few—nowhere in the world has purely voluntary action succeeded in establishing sustained yield forest management, with security for dependent communities. Instead, public regulation of private forest lands has always been necessary. It protects vital public interests. It also protects private owners who recognize social obligations inherent in forest-land management from those who might otherwise continue ruthless exploitation.

Highlights of the Year

National forests—first called forest reserves—were once administered in one Federal department while all work on which administration is based was in another. In 1905 Congress consolidated administration with research and other activities that, since they concerned both national forests and forest lands in private ownership, had always been in the Department of Agriculture.

Since then administration and research have supplemented and correlated each other; single rather than multiple responsibility has brought unity and economy; close association with other bureaus of the Department has facilitated solution of problems having to do with forest insects and diseases, forest watersheds in relation to dependent cultivated crops, farm forestry, use of forest forage by domestic stock and big game, recreation in relation to all other uses, and management of forests themselves—whether on public or private lands—as crops.

In general, these are the responsibilities and the duties of the Forest Service, which approached the fiscal year 1937 with firm belief in its established policy of integrating itself to local communities on a simple, democratic basis that makes for mutual understanding of mutual problems; with a renewed feeling that forest conservation means use with renewal in ways that will bring added security to the Nation.

Distressed regions.—Exploited forests are measured by more than billions of feet of timber gone, millions of acres of wild land tax-delinquent, potential business lost, or ghost towns. These are bad enough, but distressed regions—where values are so low that disheartened and underprivileged populations struggle for a bare existence—are worse. To a large extent rural regions now presenting such social and economic problems are forest regions; conditions within them are due in large part to forest exploitation; human rehabilitation depends in large measure upon forest rehabilitation.

With minor exceptions these distressed regions include 1,300 counties, half our farms, some 58 percent of all farm tenants. Here the average farm is 87 acres, of which 35 are forest land, compared with 222 acres (with 29 acres in forest) in all other counties. Average value of land and buildings is \$1,995 per farm, compared with \$7,659 in all other counties. Large families are the rule. There are 700 to 1,000 children under 5 years old for every 1,000 women of childbearing age, compared with 600 for most Corn-Belt farming counties, and 280 in some cities. Index of average farm income is under 30, compared with 90 to 120 for typical Corn-Belt counties. Living standards are low, educational facilities meager, undernourishment not uncommon.

To better conditions in these distressed regions, sixty-odd percent of which are forest and wild lands, residents must have part-time work. The potential significance of forest lands, previously exploited, is that in general they are capable of being rebuilt; that although conditions and opportunities for early returns vary from locality to locality, publicly financed, worth-while work on these forest lands can replace a publicly financed dole; that under management these lands can then produce continuous forest crops and afford a more nearly normal standard of living within areas from which much of our future population will come.

Forest communities.—The Federal part of the forest-acquisition program (p. 6) falls largely in these distressed areas, as do some existing national-forest purchase units. One, on the Piedmont Plateau, illustrates the human problems and responsibilities involved. There are 431,000 acres within its boundaries, with 70 percent forest land. Of the 3,000 families on the area, 75 percent are tenants, renters, sharecroppers, or squatters, mostly of long standing. Farms are small, and scattered. The country is rich in forest resources, yet among the homes leaky roofs and earthen floors are common; sanitary facilities the exception rather than the rule. Now only a bare existence is possible.

Land classification reveals small areas that, though now largely second-growth forest, are capable of growing home gardens and perhaps light yields of such crops as cotton. These areas will be used to supplement nonforest land, most of which is now cropped. Forest lands were exploited before Federal purchase began, but rebuilding them will afford opportunities for supplemental cash incomes. With farm and forest lands properly managed, the area should ultimately provide the 3,000 families a reasonably good standard of living.

Under such conditions no attempt to move these people en masse will be made. Instead, and in cooperation with State, county, and other Federal agencies, the Forest Service is attempting simple rehabilitation in place.

In a national forest in the Appalachians, another solution is under way. Here sturdy and independent settlers have for decades lived in a harsh environment. Each family has cleared an acre or two of forest land and cultivated crops, but in a few years the land wears out and is reclaimed again by forest growth. Then the process is repeated. Under industrial ownership most surrounding forest land has been exploited, but on the national forest there remains some virgin timber and enough merchantable second growth to provide, under sustained-yield management, 3 to 4 months' work each year for a limited number of people. And outside the national forest, but within 15 miles of it, is soil which with care can continuously produce worth-while cultivated crops.

With funds and authority from the former Resettlement Administration, and under standards which it approved, the Forest Service bought some of this land, subdivided it into small farms of from 3 to 10 acres each, and has now completed 64 modest but modern home units. National-forest timber is being advertised for sale. The highest bidder will be required to harvest this forest crop so the operation may continue year after year. He will also be expected to employ settlers who are coming—after investigation and approval on the basis of voluntary applications—to their new home units from certain nearby mountain territory. Direct employment of settlers for logging operations in publicly owned timber, with sale of classified products through competitive bids to processors, may be a possible alternative.

Except that it is smaller than average, the family described below is typical of this region. It had a one-room log cabin, built probably 100 years ago, with a few cultivated acres. The father had odd jobs whenever possible. The wife, 38 years old, had been three times to the nearest town, which is only 17 miles away. The two children, 11 and 15, were introduced to ice-cream cones less than a year ago, with an emotional pressure wonderful to behold. The delight of this family in their really cultivable land and their new home is almost unbelievable. Twenty-four hours after moving in, the field had been plowed and corn planted.

Acting for the former Resettlement Administration, the Forest Service has also established a small forest community in the Lake States. It provides opportunities to isolated farm families previously residing in areas which under local rural ordinances are now zoned against farming. New units on this project are 20 acres in size. Occupants will engage in part-time farming, and will be employed part time in forest work on a national forest. As resources are made available, experiences gained and results obtained in these and other forest communities will be applied to distressed regions now or later included in the national-forest system.

Unemployment relief.—For decades the Forest Service has done long-range planning. In managing timber, forage, recreation, and other forest-land resources, it has recorded and kept up to date, comprehensive work programs. When the late world-wide depression struck, and social problems became acute, these programs were expanded and became bases for action which enabled forest lands to help relieve human distress through unemployment relief.

The Civilian Conservation Corps.—Protection for Federal, State, and private forests against fires, pests, and diseases has been an outstanding contribution of the C. C. C., but it has not been the only one. With it have gone development, improvement, and extension. Trained and guided, youth of the Nation have built trails, bridges, lookout towers, firebreaks, telephone lines, cabins, and shelters. They have cleaned out underbrush and old and diseased trees; thinned and improved young forest stands so that they may grow faster; gathered tree seed, established forest nurseries, grown seedlings, and planted them.

Nor have forage and wildlife resources of forest lands been neglected. Reservoirs and drift fences have been built, and areas overgrazed by domestic livestock or big game have been reseeded. To improve fishing in many of the 70,000 miles of streams in national forests, deflectors and dams have been put in, ponds built, millions of small fish planted. To help increase our remaining wildlife, game has been counted and its life histories studied; seed for food sowed and shrubs for coverts planted. And to help save soil and water, simple check dams have been built; trees, shrubs, and grasses established; gullies or sheet erosion retarded or stopped.

Annals of the Army and Navy afford thrilling stories. So do those of the C. C. C. It, too, has been a first line of defense in national and local emergencies. Its record includes service in a Florida hurricane, an Alabama tornado, and a Nevada blizzard; in floods on the Potomac, the Ohio, and the Mississippi; in forest fires in New Jersey, Idaho, and California. It has helped find lost air liners, check infestations of gypsy moth, Dutch elm disease, bark beetles, blister rust, twig blight, and grasshoppers; has helped make nearly 2 million young men healthy through worth-while work during the last 4 years; and has focused public attention on the need for a national program for conservation of America's forest resources.

C. C. C. accomplishments, in statistical form, are available from the office of the Director of the C. C. C. in Washington. For the year ended March 31, 1937, the Forest Service supervised the work of 964 camps, of which 481 were on national forests. Distribution and average yearly number of C. C. C. camps under Forest Service supervision during each of the last 4 years will be found in table 19. The value of job training, always part of educational work within the C. C. C., is attested by the hundreds of thousands of boys who have left the camps for work in the outside world.

The Emergency Conservation Work Act of March 31, 1933, covered a broad field. It helped forest research tremendously; provided for Federal purchase of lands suitable for national forests and wildlife refuges. On June 28 of this year the President approved a bill extending the Civilian Conservation Corps for a 3-year period beginning July 1, 1937.

Other unemployment relief.—Forest work expanded during the depression through Public Works, Civil Works, Transient Relief, and Drought Relief agencies. On all Forest Service projects as high as 80 percent of direct labor was used. As peak needs receded, unemployment relief—other than through the C. C. C.—was continued by allotments from the Works Progress Administration. Its fiscal year 1937 unemployment quotas for Forest Service projects have been exceeded, with worth-while work extended to the equivalent of 20,137 people on a year-long basis. In addition, the equivalent of 2,257 man-years of employment was made available through National Youth Administration projects, and others financed by direct W. P. A. allotments to States. Overhead and equipment were held to a minimum. Costs, held well below sums authorized, permitted savings exceeding a quarter of a million dollars.

Personnel management.—Analysis to develop better methods of obtaining well-qualified and trained individuals who wish to make forestry a career has resulted in (1) closer contacts with forest schools, and more cooperation from them in training and selecting men; (2) more careful selection and placement of students in summer jobs, to give pre-entry training; (3) more intensive use of the probationary period, both as a test of fitness and as a period of planned training under constructive leadership. Personnel management throughout the Forest Service is based on principles of modern employer-employee relations.

Library.—The library, organized early in the history of the Forest Service, is now a leading one in its field. It renders increasingly valuable aid to research, administration, and forestry generally. During the past year current periodicals were scanned and articles indexed in the card catalog and in Forest Current Literature, issued bimonthly to forest schools and forestry agencies at home and abroad. Library catalog cards numbering 46,700 were furnished forest experiment stations, national-forest regional offices, and forest-school libraries; 6,289 books were circulated to individuals; 1,383 consultants came to the library for information; 4,632 pages, printed in foreign languages, were translated.

Audit.—Tabulations in the Appendix show Forest Service expenditures for the fiscal year. Sums involved, and the fact that the organization is a far-flung one, make it essential that there be a practically continuous, independent, thoroughgoing audit. In all subunits in each region, as at experiment stations, the Forest Products Laboratory, and the Washington office, each expenditure is subjected to close scrutiny prior to payment to insure conformity with applicable laws, regulations, and decisions. Field auditors frequently audit and review transactions and accounts—including those affecting property and claims—of the 10 regional foresters, 12 experiment station directors, 1 forest-products laboratory, 146 forest supervisors, and 750 district rangers. Accounting records for appropriations and revenues are maintained under close fiscal supervision. Advice of fiscal experts is constantly available in connection with policies, orders, and instructions which involve fiscal, legal, and procedural problems.

Cooperation.—Primarily a field service, work of the Forest Service is conducted through a decentralized, territorial organization. Broad policy is controlled, and coordination and correlation are secured, by its Washington office, but research is directed through 12 forest experiment stations and the Forest Products Laboratory; all other activities by 10 regional offices. In the fiscal year 1936 regular field personnel, under civil service appointment, exceeded 3,500. Cooperation is a vital factor in all work.

Land planning and recreation.—Cooperation extends to many activities, including organized recreation and land-planning. Constructed, staffed, and maintained by county or municipality, more than 50 national-forest summer camps and playgrounds furnish worthwhile summer vacations to city and valley residents who might not otherwise be able to afford them. Similar arrangements are in force with more than 300 service clubs, religious, charitable, and other organizations. In Oregon and Washington 50 Forest Service representatives serve on regional, State, and county planning boards, planning for better forest-land use. This is in addition to cooperative work with farm and industrial owners of forest lands (p. 7) and cooperation in fire protection (p. 27).

During the winter of 1936 representatives of the Forest Service met with the subcommittee on recreation of the interdepartmental committee on health and welfare activities, of which Eduard C. Lindeman was chairman. Outlining its recommendations for coordinating recreational activities of various Federal Departments, this committee analyzed

major reasons for the growth of leisure-time activities during recent years, and definitely recognized recreation as something that has developed naturally and in connection with other primary national-forest uses. It pointed out that recreation must be promoted by many agencies, including bureaus of the Departments of the Interior, Agriculture, and Labor and emergency agencies such as the National Youth Administration, the C. C. C., and the W. P. A., else it would be unnecessarily restricted and ineffective. Suggesting the need for a focal point through which Federal policies might be correlated, the committee also expressed the belief that the fundamental principle of territorial integrity must govern the actual administration of recreational activities by land-management agencies.

Forage.—Grass and browse occur in the national forests in combination with timber, and on higher portions of many major watersheds. More than 83 million acres of national forests are used, each year, by some 1½ million cattle and horses and nearly 5½ million sheep. Field work on the project of reexamining allocation of national-forest grazing privileges is now practically completed. The approach has been mainly through an analysis of economic elements surrounding range and cultivated-crop conditions in selected representative areas. In the analysis and the general application of results, the effort will be to correlate national forest range privileges with long time social and economic needs of each community. (See Distribution Survey, p. 20.) No major changes in administrative policy will be made until proposals have first been presented to interested agencies, including cooperative neighborhood livestock associations. The latter now total 763 in territory tributary to national forests in the West.

At the request of the A. A. A., and largely financed by it, the Forest Service also acted during most of the fiscal year in a technical and advisory capacity in the range conservation program. In the West it assigned experienced men to supervise the job of determining private land range capacities and acceptable grazing practices. It also examined some 50 million acres of range, and suggested and helped develop a manual of Technical Instructions for Range Surveys which is adopted as standard by the former Resettlement Administration and the Soil Conservation Service of the Department of Agriculture, and the Indian Office and the Grazing Division of the Department of the Interior.

Naval stores.—In 1936 and 1937 the A. A. A. financed but delegated to the Forest Service administration of the naval stores conservation program. Field administration is by the regional forester at Atlanta, Ga. Experienced inspectors and checkers work out of Savannah, Ga., and Jacksonville and Pensacola, Fla. Cooperation is maintained through district advisory committees of the American Turpentine Farmers Association. The program encourages such practices as conservative chipping, better fire protection, and use of a larger diameter limit for trees bearing one and two operating faces; helps provide better yields and conserve forest-land resources. Delegation of authority by the A. A. A. avoids duplication of an existing organization and simplifies relations between farmer and the Government.

Wood-lot management and marketing.—Effective and practicable methods for organizing and operating farm wood lots on a cooperative basis are being worked out on a project near Cooperstown, N. Y. The object is to assure owners the benefits of collective action in managing their wood-lot holdings and in harvesting, processing, and marketing their forest crops. Originally the Otsego Forest Products Association, this project constitutes a case study of cooperative management in rehabilitating farm forests and providing revenues to 232 member farm-woodland owners. A loan of \$99,000 was obtained from the former Resettlement Administration to provide working capital and finance construction of a processing plant.

Reforestation.—Typical of cooperation by representative organizations is that by the General Federation of Womens' Clubs in 1936 and again in 1937. Renewing and stimulating interest in administration and use of the national-forest system generally, this carefully prepared plan—conceived by the chairman of the conservation division of the federation—also resulted in club reforestation projects throughout the United States.

Planting sites were selected by clubwomen, who financed the work done there by experienced Forest Service personnel. Gavelts made by the C. C. C. from woods characteristic of local regions were presented to individual clubs as awards of merit. A special gavel was used by the president of the federation during its 1937 council meeting at Tulsa, Okla. The largest State project was conducted by Illinois clubs.

Education.—During the calendar year 1936, public interest in forest conservation found expression in 51,000 inquiries received by the Washington office alone. This was an increase of 20,000 over the preceding year. Particularly noticeable were educational activities of clubs and societies, and a well-defined demand for instruction in conservation in schools and colleges. Assistance was rendered, throughout the year, in assembling accurate and up-to-date material about conservation through use of renewable resources.

A Nation-wide forest-fire-prevention campaign, launched early in 1937, centered about a painting created and donated by James Montgomery Flagg. Accepted by the President, it is now reproduced in poster form. Production and Nation-wide distribution were made possible in large part by cooperation with various national and other associations and organizations.

In cooperation with the Department and the National Broadcasting Co., the Forest Service continued preparing material for that portion of the Farm and Home Hour program entitled "Uncle Sam's Forest Rangers."

Flood control.—The Omnibus Flood Control Act of June 22, 1936, established a new Federal policy in flood control. Under it the War Department remains the national agency for downstream engineering, including levees, dams, and other engineering works, but the Department of Agriculture is now recognized as the agency to undertake investigations and measures for run-off and water-flow retardation and soil-erosion prevention on watersheds.

This work must be cooperative. The Secretary of Agriculture has therefore created a flood control policy committee. It includes chiefs of the Bureau of Agricultural Economics, the Soil Conservation Service, and the Forest Service. The Director of Information for the Department is its chairman. Correlation is provided by a flood control coordinating committee with members from the three Bureaus concerned, and liaison representatives from others. During the past year this correlating committee has developed an integrated program of work within the Department, and effective cooperation with the War Department.

With the Omnibus Flood Control Act, and the fact that nearly one-third of our continental land area is forest land, work previously handled as a part of forest-management research and of range research now calls for greater attention. Accordingly, a *Division of Forest Influences* was set up during the year.

At the crossroads.—The deep South ¹ is ordinarily thought of as a land of corn, sugarcane, and cotton, yet the forest survey shows at least 60 percent of it still in forest growth. If its power to produce successive forest crops is restored, this forest land—95 percent of which is in private ownership—will be one of the region's soundest bases for prosperity. Recently planned investments by pulp and paper interests about double this industry's demands on southern forests that have for decades been exploited for lumber, naval stores, and other forest products going to national and world markets. In organized groups, southern pulp interests have endorsed woods-practice rules which, however, are inadequate to assure sustained-yield operations.

Pulp representatives have bought timber rights from many farmers. Certain of these rights cover forest lands said to bear 10 to 20 cords per acre, with some stands growing at the rate of a cord per acre per year. Assuming a purchase price of only \$3 an acre, with a long term of years in which to operate, and contracts that call for cutting all timber—without leaving a basis for future crops—the stage is set on such lands for reexploitation. And if such a practice continues, the land, the farmer, and the whole social and economic set-up must inevitably suffer.

The South stands now at the crossroads.

¹ Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, South Carolina, and Texas.

National-Forest Administration

Mention of the national-forest system will be found on pages 4 and 9; expenditures for national-forest protection, improvement, reforestation, and extension, and receipts, are tabulated in the Appendix.

National-forest properties.—Gross area of national forests as of June 30, 1937, was 211,521,166 acres. The net was 171,403,306 acres, with 1,248,895 acres in course of purchase. Purchase units not yet established as national forests included 1,312,798 acres actually acquired to June 30, 1937, under the Weeks law, and 440,398 acres in process of acquisition. Current additions to and eliminations from national forests are shown in table 1. They resulted in an increase of 14,086,649 acres in gross area. Eliminations were minor except for the Wichita National Forest, transferred to the Bureau of Biological Survey. The Santa Barbara Forest, Calif., was renamed Los Padres. Certain areas were transferred from one unit to another to simplify protection and administration and reduce costs. Record of purchase units given national-forest status during the year will be found on page 15.

LAND ACQUISITION

There are several major problems for which acquisition and management of forest lands by State or Federal agencies appear to be the most effective, perhaps the best practicable, solution.

One has to do with land utilization. Extensive surveys show 150 to 200 million acres once bearing virgin forests but now badly depleted or otherwise unattractive to private enterprise. Originally exploited, these lands have been repeatedly culled for such things as fence posts and cordwood. Fires have been numerous and unchecked; sheet and gully erosion are common; tax delinquency is prevalent. Already a no man's land, these areas are becoming an eyesore and a public menace. Yet on the whole they are still valuable for forest purposes. Taken in time, protected and properly managed, forest growth can be restored on them. Instead of an ever-present menace, with resources renewed these lands can contribute to local and national security.

A pressing human problem is another with which public acquisition of forest lands has to do. As indicated on page 9, distressed regions—which include half of all farms, 58 percent of all farm tenancy, people with small incomes and big families—are to a large extent coincident with exploited forest lands. Yet worth-while work on these lands, publicly financed, can replace a publicly financed dole, rehabilitate a disheartened and underprivileged population as well as the land and its resources.

Public acquisition and management of forest lands also has its place in the national job of watershed protection; in providing food and shelter for our remaining wildlife and health and happiness to millions of vacationists; in making opportunities for industry and labor; in bringing social and economic security to families and communities. Indeed, if private owners of forest lands do not redeem their public responsibilities, State and Federal acquisition—on a scale greater perhaps than that suggested on page 7 seems the only practicable way adequately to protect the broad public interests at stake.

Acquisition through exchange.—Private lands best suited to public ownership, now within national forests, are gradually being acquired by exchange under the act of March 20, 1922 (42 Stat. 465) as amended, and that of March 3, 1925 (43 Stat. 1215). Medium of exchange is national-forest land or stumpage. Among exchanges approved during the fiscal year by the National Forest Reservation Commission were seven with Michigan. They involved 85,294.33 acres of offered lands, valued at \$243,621.66, and 73,834.34 acres of land selected by the State, valued at \$243,616.99. As a result of these and similar transactions both State and national forests will be consolidated, and costs of administration and protection reduced.

Eighty-eight specific private-land exchanges conveyed to the United States, during the year, 150,036 acres valued at \$494,243. There was granted in lieu 31,449 acres, valued at \$55,145 and 119,694,000 board feet of national-forest stumpage with a total appraised value of \$283,776. Net gain in national-forest area was 118,587 acres. In addition the Secretary of Agriculture approved and referred to the Secretary of the Interior for further action 117 cases involving 222,230 acres of private lands valued at \$1,355,080; 84,026 acres of national-forest land valued at \$310,578; and national-forest stumpage valued at \$903,300.

Exclusive of those with certain States, 1,284 exchanges vested in Federal ownership 1,999,455 acres valued at \$7,159,205. This is to and including June 30, 1937. In lieu, the Government granted 510,667 acres valued at \$2,107,415, and 1,517,686,000 board feet of national-forest stumpage valued at \$3,970,069. Net result enlarges the national forests by 1,488,788 acres, increases the volume of national-forest stumpage eventually available for economic uses, and simplifies and reduces costs of national-forest protection and management.

Acquisition through purchase.—As of June 30, 1937, 35 States and Puerto Rico have granted consent to Federal purchases of forest lands for national forests, either throughout the States or in parts thereof. Several purchases involve areas which contain stands of merchantable timber. Placed on a sustained-yield basis, rather than being hastily liquidated, these areas will ultimately help stabilize local communities and industries.

Purchase of 6,595 acres in the Mary's Peak unit, Oregon, will help protect domestic water supplies for Philomath and Corvallis. Purchase of 15,420 acres in Provo and Davis Counties, Utah, will make it possible to carry forward a soil-erosion program now well under way. The year also marked initial purchase of lands in the Arrow Rock unit of the Boise National Forest, Idaho, originally established to help protect the Arrow Rock Reservoir, now seriously silted by erosion.

No new purchase units were established during the year. Additions to established purchase units included the Armuchee and Lookout areas to the Chattahoochee, and others to the Sumter, Huron, and Hiawatha.

During the fiscal year the Angelina, Conecuh, Chippewa, Croatan, Cumberland, Davy Crockett, Hiawatha, Sabine, and Sam Houston purchase units were proclaimed national forests, under names given; the Wambaw under the name Francis Marion. The Long Cane, Enoree, and the South Carolina part of the Nantahala were consolidated as the Sumter National Forest. The Mesaba purchase unit was added to the Superior National Forest, the Okmulgee and Talladega units were designated as the Talladega National Forest, the Unaka unit was added in part to the Pisgah and in part to the Cherokee National Forest.

At two meetings during the year the National Forest Reservation Commission approved for purchase 425,637 acres at an aggregate purchase price of \$2,124,736. Area vested in Federal ownership by final payment and recording of deeds during the year aggregated 3,450,202 acres. In addition to lands acquired by purchase, the Federal Government holds within the same areas 2,531,929 acres acquired by donation and reserved from the public domain, and 276,538 acres acquired by exchange. Its complete holdings within purchase units aggregate 17,048,088 acres. In addition 1,758,956 acres are in course of purchase. Details are given in annual reports of the National Forest Reservation Commission.

At the close of the year there had been approved and established under the Weeks law a total of 81 purchase units in 31 States and Puerto Rico, and all acquisition funds carried in the 1937 regular appropriation bill, \$2,500,000, were obligated. No allotments for the purchase of forest lands were made from emergency funds during the fiscal year.

Acquisition through donation.—The Secretary of Agriculture is authorized, under the acts of June 7, 1924 (43 Stat. 653) and March 3, 1925 (43 Stat. 1133) to accept donations of land for national-forest purposes. During the year 28 tracts, embracing 38,644 acres, were donated. Total donated to June 30, 1937, is now 279,573 acres. In general this is and cut over years ago, but now bearing second-growth stands. Donations of small areas for administrative purposes were also made.

Abstracting.—On January 8, 1937, the Secretary of Agriculture approved transfer from the Solicitor's Office to the Forest Service of the responsibility for abstracting land title records, getting "curative material", and procuring and recording a sufficient deed to the United States in acquisition cases. The 190 persons transferred or detailed from the Office of the Solicitor to the Forest Service to carry on this work are now part of the Forest Service organization.

NORTHERN PACIFIC LAND GRANT

Hearing in the suit to adjudicate the equities of the Northern Pacific R. R. Co. under the land grant of July 16, 1864, and resolution of May 31, 1870, was held before a special master at Spokane, Wash. After he submits his report to the court, the Government and the company will be allowed to file exceptions, provided they so desire. Under the act of May 22, 1936, either party to this suit has the right of appeal to the Supreme Court of the United States for final decision relative to points of law. Prospects of final decision at an early date seem remote.

RESETTLEMENT LANDS

The former Resettlement Administration had planned eventually to turn certain of its acquired lands over to the Forest Service for administration as parts of national forests. Informal agreement was reached, legal and procedural questions are now being worked out, and transfer may be expected of lands which can most effectively and economically be administered as parts of the national-forest system.

BOUNDARY ADJUSTMENTS

Need still exists to protect and administer some 12 to 14 million acres of public-domain timberland and woodland outside the national-forest system, and to make certain other national-forest boundary adjustments. One of the most critical problems is where certain narrow strips of foothill lands lie between national forests and cultivated valley lands. In many such cases valley stockmen depend upon foothill lands, administered by one Federal agency, for spring and fall range; upon nearby national-forest lands, administered by another agency, for summer range. To secure effective and economical administration, and to prevent confusion, both foothill and mountain lands should in such cases be under one administrative agency.

During the fiscal year 32 bills were introduced in Congress covering 22 individual cases of this type, but none received approval by both Houses of Congress. Clearance was obtained in the executive branch of the Government, however, for addition of one such strip to the Uinta National Forest, Utah, and another to the Harney National Forest, S. Dak. In both these States additions can be made by Presidential action.

CLAIMS, SETTLEMENT, SPECIAL USES

Final application for patents for lands within national forests totaled 93 for homesteads, 74 for mineral lands, during the year. On the former, 71 favorable reports were made by the Forest Service and 22 unfavorable; on the latter, 57 favorable reports were made and 17 unfavorable.

There are practically no national-forest lands now suitable for entry as homesteads. Recommendation is renewed that mineral land laws, insofar as they apply to national forests, be modified so claimants may obtain title to the ore body only, with right to use as much of the surface as is necessary to carry on mining operations. In no way interfering with bonafide mining, such an amendment would prevent use of mineral land laws for acquiring title to national-forest lands for nonmining purposes.

Uses of small areas of national-forest lands under special use permits show a steady increase. Number of such live permits at the end of the fiscal year was 40,722. This is 1,355 more than were in force at the beginning of the year. Rental charge was made on 22,112 of these permits. The remainder were issued without charge. Special-use receipts for the fiscal year totaled \$340,492.93.

SURVEYS, MAPS, PHOTOGRAPHY

All Forest Service surveying and mapping conforms to standards established by the Federal Board of Surveys and Maps. Map and survey data of other Federal agencies are used when they are available and can be supplied within a reasonable time. Maps for administrative use have been published on various scales for most national forests and purchase units. Recreational folder maps and special maps are also published, and relief models have been prepared for many western forests.

Aerial photography during the year covered 11,500 square miles. Surveying by ground methods covered 1,280 square miles. At Forest Service photographic laboratories in Washington, in addition to the regular work, photographic requisitions are filled for 12 other Government bureaus.

PROTECTION FROM FIRE

During the first 5 fire seasons after national forests were transferred to the Department of Agriculture, weather conditions were relatively favorable, as they had been since about 1889. In 1910 fire danger unexpectedly assumed explosive characteristics. Since then there has been 1 comparable bad weather year during each of the half decades from 1915 to 1924, inclusive, and 2 bad years in each of the half decades from 1925 to 1934, inclusive. As is indicated by the fact that 58.7 percent of the national-forest area lost from 1910 to 1924 was burned in 7 bad years, this increase in frequency of extreme years is one fairly reliable index to the unfavorable trend of fire weather to date.

Forest-fire control as a science began as a result of the 1910 season, when nearly 5 million national-forest acres were burned over and damage to tangible values exceeded \$24,000,000. Since this disaster the weather has taken on increasingly unfavorable characteristics, and human use has increased enormously, but the technology of fire control has advanced to a stage which now entitles it to a place among modern developments in science and industry.

In perspective, accomplishments since 1910 in forest-fire control on national forests are indicated by a well-sustained downward trend of area lost. Average number of acres burned per 1,000 acres protected has dropped from 7.2 in 1910-14 to 2.1 in 1931-34, with an average reduction during each half decade of 27 percent from the average for the previous half decade. National-forest average for 1935-36 is only 1.6 acres burned per 1,000 acres

protected. The record for 1937 may approach that for 1930 and 1933, when losses were held to eight-tenths of an acre per thousand. The record for 1935 and 1936 is given in table 7.

To maintain the previous rate of 27 percent reduction in average loss for each half decade will become more difficult as losses are brought closer and closer to the irreducible minimum. To balance this influence of the law of diminishing returns, new measures to guard against surprise fires, and to strengthen the complicated structure of forest-fire control, are being employed. Among them are:

Rechecking and replanning.—The general purpose is to discover and correct weak spots before they are disclosed by disastrous fires. Relative fire danger under varying conditions is being carefully reanalyzed, and the latest techniques employed to determine whether fire lookout stations, road and trail systems, and other facilities have been so planned as to guard most effectively against runaway fires.

Fire-weather forecasts.—Progress has been made by the Weather Bureau, Department of Agriculture, in forecasting fire-weather conditions. Specialists have been equipped with mobile units for ascertaining and interpreting weather conditions in particular localities. Fire-control executives are beginning to receive the forecasts they must have to handle their work intelligently. It is hoped this development will continue until reliable fire-weather service is supplied as needed.

Fire-control techniques.—There are now available, as a result of research and experimentation, certain techniques which make it possible to provide fire-danger meters. These instruments are in use in two national-forest regions, permitting day-by-day determination and integration of moisture content of forest fuels, humidity, wind velocity, and other fire-danger elements. This gives flexibility in management of man power in relation to actual day-by-day fire danger. Research expects to provide a danger meter which will make such flexibility possible for every national-forest region.

Technology of forest-fire control has produced many items of specialized equipment, now described in a new fire-control equipment handbook. To promote standardization and facilitate purchasing, complete specifications have (where appropriate) been included. They are available to executives, manufacturers, and others interested.

Training.—Most forest fires are discovered and handled in their early stages by guards working alone or in charge of small groups. Results, in these critical stages, may largely be measured by the judgment and competence the individual fire guard puts into his work. Training, always essential under such circumstances, is doubly so because fire guards are employed each year for a period of about 3 months only, and they naturally seek better and more permanent jobs. This necessitates making protection activities click with a guard force ordinarily made up of from 25 to 50 percent of green men each year. To help meet this situation spring training camps are provided, as are frequent inspections on the job. To supplement and complement these measures, a fire-suppression handbook has been distributed. After revision, it will be made available outside as well as within the Forest Service.

Chemicals.—Under direction of a chemical engineer of experience in its application to municipal fires, a systematic effort is being made to utilize fire foam in fighting forest fires. Besides a tank, this requires a new type of double hand pump, carried on men's backs and operated by individual fire fighters. Already developed and tested, the tank is a two-chamber affair containing two solutions of foam-producing chemicals. When the foam solutions—which it is hoped may be several times as effective as equal weights of water—are not available, water can be used. Engineering and chemical problems involved in the use of foam solutions from forest fire-fighting tank trucks have also been solved during the year, and one test tank truck has been produced.

Aircraft.—Because of distances involved, and time required for ground transportation, forest-fire control has turned to aircraft for rapid transport. During the year new methods have been developed for the dropping of supplies and equipment from moving aircraft. They are simple, can be applied by inexperienced men, and use materials available at any small town. This makes possible high-speed transport of materials to exact spots needed in fire-fighting operations; spots often unreachable within time limits necessary to successful fire control by ground transportation. Experiments have also been carried on in dropping chemicals from the air directly onto going forest fires. If the autogiro type of aircraft is developed to larger pay-load capacities, many obstacles in the way of treating fires from the air will be removed.

PROTECTION FROM TREE DISEASES AND INSECTS

Continued improvement in conditions in 1936 reduced the need for control of forest insects on national forests. It was again possible to devote a large portion of insect-control funds to extensive surveys permitting discovery of incipient infestations before they reached epidemic proportions. This was good insurance.

Bark beetles.—Oregon and Washington have experienced heavy timber losses from bark beetles. For the period 1931–35 those losses totaled 4,500 million feet board measure;

only 100 million feet less than the total lumber cut for that period. Now the condition improved there. Losses on forest land in all ownerships have fallen from 1,707 million board feet in 1932 to an estimated 400 million board feet in 1936.

Total number of trees treated for bark beetles during the year on all national forests was 66,631. The situation is still threatening on some areas.

Tent caterpillars.—The tent caterpillar has badly defoliated white birch and aspen stands in the Lake States. Most serious epidemics have occurred on the Superior and Chippewa National Forests, used extensively for recreation, in Minnesota. Caterpillars so polluted the waters, and were so obnoxious generally, that recreationists appealed to the Forest Service to start control. This was done, on restricted areas having high recreation use, by spraying trees with an arsenical poison. Results proved effective locally. A total of 520 acres were treated, in 65 different locations. Private owners and civic organizations cooperated financially.

A single infestation of this insect seldom kills a large portion of the stand, but repeated infestations will. They also weaken the trees and leave them subject to attack from other insects and fungus diseases. This infestation covered so big an area that with funds available broad control was impracticable.

White-pine blister rust.—Blister rust has now spread to all important white pine regions in the United States and Canada. The major control problem is now in valuable white pine types of the West, where 2,500,000 acres of national-forest lands still need protection. During 1936, 140,000 acres of western white pine in northern Idaho, eastern Washington, and western Montana, and 74,800 acres of sugar pine in southern Oregon and northern California, were placed under protection. In the former area, with some 1,392,000 acres still to be cleaned of *Ribes*, 885,000 acres have been covered to date. Spread of the disease during the last year has been very rapid. Unless control efforts are greatly increased large areas of valuable young white pine will be killed. Even at the increased 1936 rate at least 4 more years will be required to complete initial control. To be properly effective control should be completed within the next 2 years.

Choice sugar pine stands in Oregon and California now segregated for protection aggregated 1,108,000 acres. Largely because efforts have been centered in western white pine, control in sugar pine has not yet progressed very far. If this pine is to continue as an important commercial species, prompt protection must be provided.

In the northeastern United States the advance of blister rust has been fully arrested by control. This shows what can be accomplished in the West if adequate steps are taken promptly. In Georgia, North Carolina, Virginia, West Virginia, and Tennessee, some 139,000 acres in national forests were protected against blister rust during the year. In the Lake States, where extensive stands of northern white pine are found, 89,821 acres in national forests were protected.

TIMBER MANAGEMENT

Market conditions and sales.—Improvement in demand for lumber continued through 1937. Prices rose, production increased, markets remained firm. National-forest timber sales showed increased cutting activity and caused some financial difficulty in providing personnel necessary to give proper administration.

Demand for new sales of national-forest stumpage increased sharply. Use of trucks and tractors stimulated selective logging. This made it possible to sell small, isolated tracts of timber not previously marketable. As protection to a stand of virgin fir, and as a salvage operation, one sale on the Olympic National Forest covered dead and down timber only. The operation was a success. The purchaser wanted more.

National-forest timber cut under sales and land exchanges during the fiscal year totaled 1,290,610,000 board feet, an increase of more than 26 percent over 1936. Receipts totaled \$2,849,382, an increase of \$687,711. No large sales were made to supply new milling capacity.

All classes of sales increased during the fiscal year 1937. Transactions covering miscellaneous products such as turpentine, shrubs, burls, Christmas trees, tanbark, and bow staves, totaled 1,214. Timber sales under \$500 in value totaled 18,863. This was an increase of 652 over 1936. Those having a value of over \$500 totaled 263, 85 more than in the previous year. Total for all three classes of transactions was 20,340. Demand for fuel, fencing, and building material increased during the late depression; did not fall with return to prosperity. Instead, the increase continued. Utilization of dead and down timber, and material for thinnings, is encouraged. National-forest timber sale business for the fiscal year is summarized in tables 8 and 9.

Sustained-yield and national-forest stumpage.—Despite the end of virgin timber supplies now in sight in many localities, there are situations where by practicing selective logging, by purchasing additional timber, and by willingness to reduce production, it is possible for operators of private stumpage to switch from a quick liquidation basis to one of sustained operations, and bring security to families and communities dependent on forest

resources. Wherever adjacent to such holdings, the policy is to sell national-forest timber at such times as will help convert private operations to a sustained-yield basis. The controlling policy in the sale of national-forest timber is sustained yield, and the Forest Service refuses to sell stumpage when to do so results in quick liquidation.

Stand-improvement work.—This year, as last, overcrowded and defective stands of young timber have been put in condition for good growth by thinnings and improvement cuttings, largely by the C. C. C. One instance is on the Harney and Black Hills National Forests, S. Dak. Here more than 200,000 acres of crowded and stagnated young ponderosa pine have been thinned. In the Lake States effective work has been done in spruce, red pine, and jack pine. In eastern hardwoods a large portion of the worth-while cultural work on national forests has already been accomplished, and most unworked areas now contain merchantable products which should be sold before cultural treatment is given.

Planting.—Area reforested on national forests during the year exceeded that of any previous year by 82,351 acres. Trees were planted on 214,306 acres. Tree seeds were sown on 8,769 acres. Total area reforested was 223,075 acres. Production of stock has required unusually careful planning, and development of extensive nurseries.

National forests include 4 million acres of land now nonproductive but suitable for growing forest trees. Even though reforestation was greater than ever before, accomplishments in the calendar year 1936 made little headway toward completing a job of this size. Under the Knutson-Vandenberg Act, appropriations for planting are limited to \$400,000 in any 1 year. The C. C. C., and allotments from emergency relief appropriations, made this year's program possible, but current curtailment in relief appropriations presents a real problem. Unless legislation permits larger regular appropriations it will not be possible to maintain present progress. Since it requires from 3 to 4 years to produce proper growing stock, it will be well-nigh impossible to plan in advance unless appropriations for reforestation are made permanent.

Greatest planting needs are in the Lake States and the South. Here national forests have for the most part been built up by purchases of private lands heavily cut and burned before being acquired. Much of this land, particularly in the Lake States, offers difficult planting sites, but once trees are established, the soil produces good forest stands. Generally accessible, and relatively near heavy centers of population and demand, these areas are particularly important as wood-producing centers. Yet with original forests overcut and ruthlessly exploited, lumber and other forest products must now be brought here from long distances. Freight alone costs more than the cost of the finished product not so long ago. Lumber prices are high. With forests reestablished, growing, harvesting, and manufacturing done locally, and freight rates reduced to a short-haul basis, homes and industries should be stabilized; the present picture should change for the better. Nearly 90 percent of all calendar-year planting was in the Lake States and the South.

Total national-forest area planted and sown during the calendar year 1936 is shown, by States, in table 10. Table 11 shows present approved annual output of national-forest nurseries. It has been reduced, for some larger nurseries, to permit practices made necessary by drought and other special conditions. Designed primarily to produce stock for national forests, small amounts of coniferous stock from these nurseries will again be used in State cooperative work under the Clarke-McNary law.

THE RANGE

Weather and forage conditions.—Broad and local cycles of drought in the past decade or more have emphasized the need for conservative use of forage as a factor in minimizing or avoiding economic adversities and insuring security to dependent livestock operations and communities.

In Montana and northern Idaho (region 1) drought conditions of 1935 continued. This further reduced volume and vitality of forage already affected by moisture deficiencies of nearly a decade. The Bitterroot and the Beaverhead Forests were two bright spots, but eastern Montana was again ravaged by severe Mormon cricket and grasshopper infestations.

In Colorado, western Nebraska, southwestern South Dakota, and that part of Wyoming east of the Continental Divide, more favorable moisture conditions prevailed. National forests in Wyoming and the Black Hills carried most permitted stock to the season's end. Outside ranges in Colorado and Wyoming presented a picture of forage desolation over millions of acres, and special emergency concessions were made on the Bighorn Forest. This helped relieve severe cases of distress. Livestock entered and left region 2 forests in good condition generally, although slightly light in weight when marketed.

In Arizona and New Mexico (region 3) climatic conditions were favorable except during the spring in southern Arizona. Feed was ample over most of the region. Except on the Coronado, summer ranges on the forests were better than for years. The calf crop was good, and percentage of lambs in northern New Mexico was the largest in years. Heavy snows during the winter of 1936-37 resulted in winter losses higher than normal.

Snowfall was heavy during the winter of 1935-36 in region 4 (Utah, southern Idaho, and most of Nevada) especially on outside ranges, but September to November 1936, was one of the driest periods of record. In the winter of 1936-37 many herds became snowbound on winter ranges, and Federal agencies extended material aid. On the forests, forage and livestock conditions compared favorably with 1935.

In California and western Nevada (region 5), precipitation was some 20 percent below normal south of the Tehachapi; for the rest of California it was 20 percent above. An unusually mild winter was followed by a cold and rainless spring and fall. Serious feed shortage was faced on lower outside ranges, but forest ranges were somewhat better than the previous year. Fires in northern California burned large outside acreages, contributed to serious fall and winter range and feed shortages, and materially interrupted financial recovery in that territory.

In region 6 the early winter of 1936-37 was difficult. Heavy snows in Oregon and Washington made early feeding of hay necessary, also heavy use of concentrates. Fall ranges, both on and off national forests, were dry with no fall growth of vegetation. There was, however, a favorable range outlook for 1937.

Market conditions.—Fall cattle markets were from \$1 to \$2 per hundredweight under those of 1935 for national-forest regions generally, but there was optimism among livestock producers except in areas that had experienced extreme drought or winter adversities. Values on stocker and feeder classes were penalized by feed shortages in feeder States. Adverse conditions slowed up liquidation on indebtedness in certain areas. With market improvements, and reduced interest rates and taxes, the general objective is for national-forest permittees to reduce or cancel their obligations as rapidly as practical. Easier private money and a tendency toward speculative phases have shown up in some sections. These influences are reflected in increased inquiries for national-forest range.

Range use.—In the calendar year 1936 the number of cattle permittees decreased 2 percent and the number of sheep permittees 3 percent; the number of cattle allowed to graze under permit decreased 2 percent, sheep 0.8 percent. Table 12 shows numbers grazed by States. In addition to stock under permits, 41,204 cattle, 48,585 horses, 12,317 sheep, and 909 goats were grazed in national forests under regulation authorizing free grazing of not to exceed 10 head of stock used for domestic purposes, or by prospectors, campers, and travelers, etc. For trends in range use see table 13.

Reductions.—Permit reductions in 1936 were again mainly for range protection made necessary by drought cycles and local overstocking. On nearly all national forests demands for range continue far in excess of range capacity. With growing limitations on grazing lands outside national forests, and at least until land-use planning and livestock production are better correlated with other agricultural production, this condition will continue to result in many applications that cannot be approved.

Reductions in 1936 for range protection totaled 3,139 cattle and horses and 32,097 sheep and goats, equivalent to 0.2 and 0.6 percent, respectively, of total numbers allowed in 1935. Reductions for distribution, totaling 715 cattle and horses and 5,063 sheep and goats, were largest in Regions 1 and 4. Reductions are applied first to temporary permits, which in 1936 covered 16 percent of the cattle and 13 percent of the sheep as compared to 18 percent and 14 percent, respectively, in 1935. Average seasonal use by cattle in 1936 was 5.7 months, and for sheep 3.1 months, against 5.3 and 3.1 months, respectively, in 1935. Usable national-forest area in 1936 was 88,878 net acres more than in 1935; the total 81,966,559 acres in the six western regions. Additions to national forests are mainly responsible for this increase.

Term permits.—No term permits were issued in 1935, pending readjustments in policy. Second series of 10-year term permits began in 1936, following policy approved by the Secretary of Agriculture on February 19. During the year 49 percent of the cattle and 55 percent of the sheep on national forests were grazed under this form of permit, issuance of which is governed by policy that provides: (1) Reductions for distribution, including those made in 1935, will not exceed 20 percent for the 10-year period 1936-45. (2) In any 1 year, no greater reduction than 5 percent will be made for distribution. (3) At the expiration of 1940, such reductions can be made for protection as the circumstances justify. (4) Protection and distribution reductions will be worked out separately. (5) All term permits will carry clauses determined by local conditions, specifying maximum reductions which may be made for distribution during the entire period 1936-45. (6) Reductions for all purposes during 1936-40, inclusive, will not exceed 30 percent, including reductions made in 1935; nor will they exceed 15 percent in any 1 year. (7) Adjustments to be made under this program will first be taken up with the local stockmen, and full consideration given their views.

Distribution survey.—Distribution survey was undertaken in 1935 on a representative national forest in each of the six western regions. It was expanded in 1936 to include cooperation by the Bureau of Agricultural Economics, the Division of Grazing of the Department of the Interior, and several western colleges. Field work on the initial project has

now been completed, although additional analysis of existing information is yet to be made.

This study was initiated to obtain factual information for use as a basis for policy determinations on allocation of national-forest grazing privileges, including such questions as land dependency, commensurability, protective and maximum limits, permittee qualifications, and related problems of importance. It was approached mainly through an analysis of range and other agricultural situations in and adjacent to areas selected for study. Social welfare and economic stability, usually closely related, and proper protection of the resource, are collateral objectives.

Findings in their various applications to range uses and indicated permit priorities and dependencies are now being discussed with livestock and related groups. It is hoped policies will be ready for application before issuance of national-forest grazing permits in 1938.

National-forest range resources are comparatively limited when measured against the total western range industry, which extends to about 75 percent more sheep and 85 percent more cattle than can be accommodated on the national forests. It is thus impossible to allocate a national-forest range to all who desire it. The distribution survey is attempting to reach logical and equitable answers to this situation, as well as to other major factors.

Western range conservation program.—Interest by livestock operators in range conservation and range management was given real impetus when the western division of the A. A. A. offered a range-conservation program to western livestock producers under authority of the Soil Conservation and Domestic Allotment Act of 1936. The Forest Service was requested by the A. A. A. to cooperate by examining ranching units, establishing grazing capacities, recommending conservation practices.

The program was formally offered early in September 1936. Response of western ranching operators was beyond expectations. By December 31, 29,858 applications involving 78,841,284 acres of privately-owned range land had been filed. This was approximately 22 percent of private, State, and county land which could qualify as ranching units. The Forest Service immediately proceeded to examine 56,329,422 acres of range land, establish its grazing capacities, recommend conservation practices for it. Methods employed were similar to those developed and used in similar work on national forests. Each report, in effect a simple, understandable statement of range-management needs of a ranching unit, was of immediate and direct benefit to owner or operator.

In the calendar year 1937 range-conservation program, about 35 percent of all qualifying western range lands have been offered for benefits. Because of its own administrative responsibilities, after the fall of 1936 the Forest Service furnished only a limited number of trained supervisory personnel. It also gave intensive training to those selected for the 1937 examinations, supervised their field work, and helped develop that manual of Technical Instructions for Range Surveys previously mentioned (p. 12).

Associations and advisory boards.—Local neighborhood livestock associations assure close and continued contacts between national-forest grazing permittees and forest officers. Annual meetings represent about the closest approach possible to a successful cooperative form of range management and administration. They provide opportunity for personal discussions of individual problems with permittees. At other meetings prior to opening of the grazing season range-program details are worked out. Pro rata assessments are voted for cooperative purchase of salt, hiring range riders, maintaining and constructing range improvements, and other features. Range-management plans are discussed. Mutual understandings are reached. Association advisory boards are constantly consulted by forest officers before adopting new or changing existing policies and practices having to do with administration of national-forest ranges.

The number of national-forest associations has increased steadily for many years. In 1936 there were 763, with 711 meeting all advisory-board requirements. Rarely has an association been discontinued when once organized. These organizations and their meetings have kept misunderstandings between permittees and the Forest Service to a minimum; resulted in worth-while accomplishments in actual range management on the ground.

Trespassing stock.—Progress has been made in better control of trespassing stock. In 1936 the total number dropped 35½ percent from that in the calendar year 1935. Better control is now possible by boundary fences and interior control fences built since emergency funds became available, including 6,996 miles of range fencing erected on the national forests since 1933. Tagging of permitted stock on areas especially susceptible to trespass has also given good results.

Livestock losses.—Table 14 shows livestock losses on national forests in 1936 and 1935. Predators continue as the largest single cause of losses in sheep and lambs. Tall larkspur is responsible for major losses in cattle. Eradication of it is generally by digging on areas of dangerous infestation.

Rodent control.—Rodent control, principally under the cooperative direction of the United States Bureau of Biological Survey, extended to 581,456 acres in 1936. Total area treated to date is now more than 13,760,000 acres.

Range surveys.—During the calendar year 1936, 3,366,459 acres were covered by intensive range surveys. Including resurveys of certain earlier and less intensive work, the total to date is now some 70,877,000 acres. Effectiveness and accuracy of aerial surveys in providing cultural data for basic ground maps in difficult terrain makes it possible to supplant much of the older ground-crew method of surveys. Good cultural maps have a primary value in providing the basis for management of individual national-forest range units, of which there are 4,325 now devoted to use by cattle, and 4,783 by sheep.

WILDLIFE MANAGEMENT

Wildlife management is a major national-forest activity. With other resources, it is managed on the multiple-use principle, modified where necessary by special programs determined by regional and local conditions and needs. National-forest wildlife resources now include some 1,600,000 big-game animals; an equivalent number of fur bearers; game birds; about 70,000 miles of trout streams; game fish in natural and artificial lakes and ponds that total thousands of acres.

About 75 percent of the big game in Western States depends upon national-forest summer range. Estimated numbers by States will be found in table 15. Possibilities of national-forest wildlife production are not limited to current numbers of game, fish, fur bearers, and birds. Average increase of big-game animals has been fully 140 percent since 1924, despite more hunters and regular open seasons on deer and, more recently, on most elk herds. But winter ranges within the forests, particularly in Western States, are relatively limited and very little outside winter range is now available for game. So as game increases, the winter-range situation becomes a controlling factor in the numbers of big game that can be cared for. In recent years at least 18 important winter problem areas have developed within national forests.

Analysis of range for wildlife, made in 1936, discloses the need of some 9,000,000 additional acres of winter range in the Western States to provide adequately for present numbers of big game. In addition, about 25,000,000 acres would be needed properly to take care of deer and elk, estimated at several times the present numbers, that national-forest summer ranges could support.

Game refuges.—At the close of the calendar year 1936, State game refuges within national forests totaled 349, their total area being 21,277,964 acres. There were also 31 Federal refuges comprising 4,080,600 acres, and 120 areas totaling 4,139,818 acres set apart by the Forest Service under administrative restrictions in the special interests of wildlife.

Refuges have proved helpful in the initial stages of game protection, but can and frequently do get out of hand through overpopulations of game unless positive measures of management and control are applied. With such management the need for large refuges becomes progressively less.

Cooperation.—Formal cooperative relations with the Bureau of Biological Survey and the Bureau of Fisheries, directing wildlife research work on national forests within their respective fields, were extended during the year. The Biological Survey cooperated in adapting forest improvement cuttings to wildlife needs. The Bureau of Fisheries secured technical data on which to base programs for improving national-forest fishing resources. It also studied Lake States locations with a view to supplying more adequate hatchery facilities in that territory. Special accomplishments included a rearing station and laboratory of 200,000-fingerling capacity on the Pisgah National Forest and Game Preserve, N. C.; additional ponds at Arrowwooddale, N. C., to give the plant there an added capacity of 60,000 fingerlings; 40 more ponds with an additional capacity of 800,000 fingerlings at the Wall Hollow C. C. C. cooperative project on the Nantahala Forest, N. C.; and completion of a large hatchery plant on the Teton Forest, Jackson Hole, Wyo., with an annual capacity of 2,000,000 eggs.

Organization.—In 1936 a *Division of Wildlife Management* was installed in the Washington office. Though wildlife activities necessarily fall in large part upon regular Forest Service personnel, 83 specialists were employed in 1936 on wildlife assignments. Functioning in most of the 10 regional offices of the Forest Service, 69 of them were trained in colleges and universities; the remainder were qualified through extended experience in the wildlife field.

About 1,500 regular forest officers participated in wildlife activities. Work programmed and accomplished includes counts and estimates of game, extensive fish plantings, studies of food and other habits, winter patrols, game hunts on Federal refuges, raising and transplanting fawns and capturing native deer on the Pisgah Federal refuge, transplanting beaver, development and initiation of cooperative agreements with States, detailed reports to cooperating agencies, and collection of data basic to management plans.

In wildlife management every effort is made to cooperate with and through different Federal, State, and other agencies, so that there may be a united and effective effort to better wildlife conditions on the national forests.

RECREATION

In effect the report to the President of his subcommittee on recreation (p. 11) recognizes national forests as a major source for outdoor recreation of inestimable social value; indicates that, already used by millions, this resource should be promoted and developed to help meet rapidly increasing national needs and demands; believes the fundamental principle of territorial integrity should govern in actual administration of recreational and other resources by Federal land-administrative agencies such as the Forest Service.

A planned forest-land use.—Until comparatively recently recreational enjoyment of forest areas in this country has been largely incidental. It is now much more than this. Instead of living in the forest, we now go there to enjoy ourselves. Forest recreation has definite values in our lives, and we want it included as a planned forest-land use.

Increasing use of national forests proves this. In 1916 they were visited by some 3,000,000 people. In 1937 people who actually used planned recreational facilities and areas included 657,359 special-use summer-home permittees and guests; 2,165,329 hotel and resort guests; 2,836,040 campers; 5,973,930 picnickers; and 18,969,280 who motored, rode horseback, and hiked, primarily to enjoy scenery and cool forest climate. The 1937 total, 30,801,938 people, does not include motorists who merely passed through en route to other destinations.

Scenic values.—When national-forest scenic or recreational values are paramount, they may be given a dominant position in land and resource use. As a rule, however, recreation in national forests is developed as one of many uses; is correlated and harmonized with existing or potential uses of other resources upon which almost one million people already depend for their daily bread and butter. The Forest Service encourages and develops simple forms of recreation; those easily available to people of limited means. To keep facilities in harmony with forest surroundings it has employed some 75 professionally trained landscape architects who, in the field, design and supervise construction of public camp and picnic grounds, fireplaces, tables, council rings, children's playgrounds, etc. Most of this work has been financed from emergency funds. To continue it, and properly to administer the recreational resource, regular appropriations larger than have been available in the past will be required.

Preserving roadside beauty.—Administrative policy requiring that strips of timber be left along forest roads is now bearing fruit. Because of it many roadsides are now bordered by areas of natural forest beauty. This policy will be continued and expanded. Through Federal acquisition of suitable strips, by purchase or exchange, it will wherever possible also be extended to forest lands which, now privately owned, may otherwise be subject to exploitation.

WATER POWER

Present estimates place one-third to one-fourth of all our water-power resources within national forests. In addition there are hundreds of irrigation projects, many small and scores of large municipal water-supply systems. Protected national-forest watersheds help all these, as well as projects for power, irrigation, navigation, flood control, and domestic water hundreds of miles away.

During 1937 the Federal Power Commission received 41 applications for permits or licenses involving use of national-forest lands. This was 73 percent of the total number filed under provisions of the Federal Water Power Act.

When the year closed the Forest Service, acting for the Federal Power Commission, was supervising operations under 407 water-power permits and licenses. Monthly reports on applications for permits, licenses, amendments, and construction, covered 146 cases. At the end of the year 184 permits and easements issued by the Department of Agriculture through the Forest Service prior to the enactment of the Federal Water Power Act were still in effect. Of these, 87 were power projects with a total estimated average low-flow output of 358,969 horsepower and total estimated installed capacity of 725,000 horsepower. Ninety-seven covered transmission lines with a total length of 840.91 miles within national-forest boundaries.

Annual rental fees were involved in 46 power projects, with an estimated low-flow output of 333,774 horsepower, and in 83 transmission-line cases with a length of 737.71 miles. No rental fee was required for 41 power projects with an estimated average output of 25,195 horsepower, and 14 transmission lines with a total length of 103.20 miles.

ROADS AND TRAILS

Mileage of the proposed national-forest transportation system is shown in table 2. This system embraces only those roads and trails which have been approved and are to be included in definite construction programs. Funds available for construction of forest roads and trails during the fiscal year 1937 included:

(1) The 10-percent fund, known as the "roads and trails for States, national-forest fund available annually under provisions of the Agricultural Appropriation Act of March 4, 1911.

(2) Forest road and trail fund, composed of forest highway and forest road development funds, appropriated under section 23 of the Federal Highway Act of November 9, 1921.

(3) Cooperative funds, provided mostly by the States.

Tables 4 and 5 show distribution among States of various road and trail funds for the fiscal year 1938, and total distribution. Table 6 shows condition of these funds at the close of the current fiscal year.

Forest highways are necessary primarily for public travel; truck trails and others primarily for national-forest protection, administration, development, and utilization. Table 3 shows by States, the miles of forest highway, truck-trail and trail construction and maintenance with expenditures to June 30, 1937.

Contributed time of agencies other than the Forest Service, evaluated at \$24,175,799 was used in constructing and maintaining forest truck trails and trails. Most of this was by the C. C. C., which from national-forest camps constructed 2,517 miles of truck trail and 325 miles of other trails; maintained 26,231 miles of the former and 11,458 miles of the latter.

Work on selecting an economical road surface for dirt roads, to help eliminate dust and loss of surface material, has been continued. Experiments in the use of calcium chloride and sodium chloride applied to stabilized earth surfaces indicate the desirability of greater use of these methods on more heavily used truck trails. Appropriate signs with information useful to the public, and forest entrance markers, have been constructed on many important roads.

State and Private Forestry

When white men first came, forests in what we now know as the United States grew on about 820 million acres. Lands most valuable for forest purposes still total about 615 million acres. This is almost one-third of our continental land area.

These forest lands are divided into two broad classes—those at present noncommercial, and those now commercial. The former total 120 million acres. Broadly speaking, private owners are not much interested in them, but because of public values for such things as recreation and watershed protection, State and Federal Governments are. Commercial forest lands, capable of growing timber now marketable, total 495 million acres. These are the ones in which private owners are particularly interested, and they now own the best four-fifths of them. The poorer one-fifth is in public ownership.

The manner in which all forest lands are handled is vital to the Nation as well as to individuals. Exploited and mined, forests disappear; under planned management, producing continuous crops for harvest, they can help maintain industries and communities permanently.

One Forest Service job is to protect, develop, and administer the Federally owned national forest system. Because of the many public interests involved, another is to encourage and help establish adequate management on forest lands in State and private ownership.

STATE COOPERATION

In Massachusetts, early forest legislation grew out of encroachment by sand dunes near Fruro, on Cape Cod, said to have been brought about by cutting timber and permitting domestic stock to graze on seaside commons. To help save Pennsylvania's forests, thrifty William Penn's original Charter of Rights provided that, in clearing ground "care should be taken to leave one acre of trees for every five acres cleared * * *." Such measures were in large part limited and local. Since then real progress has been made in forestry legislation by the States.

Progress in State forestry legislation.—The year's forestry legislation among States may in general be grouped as indicated below. Its volume makes inclusion of details in this report impossible.

That affecting State forest organizations.—Colorado placed forestry activities under a board of land commissioners. Georgia created a department of natural resources with four divisions, one of which is forestry. Minnesota replaced its conservation commission by a single governor-appointed commissioner. Missouri created a four-man conservation commission which selects its own commissioner. Oklahoma replaced the State Planning Board, Conservation Commission, and Forest Commission by a planning and resource board employing a director of forestry. Oregon added to its board of forestry one member representing the Western Livestock Association and the Oregon Cattle and Horse Raisers' Association. Tennessee transferred its forestry work to a new department of conservation. Colorado, Georgia, Oklahoma, and Tennessee required the State forester or his equivalent to have technical forestry training and/or experience. Maine excepted officers and employees of the forestry district from a newly established classified service based on merit and fitness.

That affecting State and county forests.—Alabama, Connecticut, Georgia, Idaho, Illinois, Indiana, Missouri, Montana, New Hampshire, Oklahoma, and Tennessee authorized (1) agreements with the Federal Government for purchasing land in their behalf, (2) expenditures for administering such lands as State forests, and (3) reimbursement to the Federal Government for cost of the land from proceeds secured from such forests. Connecticut authorized leasing of forest lands from former Resettlement Administration or other Federal agency, and North Carolina the purchase of land to complete an area already partially acquired for State forest use. Oregon granted counties powers to acquire and administer county forests. Pennsylvania limited the amount of delinquent taxes which counties might claim for reimbursement on lands ceded it for State forests.

Florida, South Dakota, Tennessee, and Washington provided for clearing title to tax-delinquent lands suitable for State forests. Idaho, Indiana, Massachusetts, Minnesota, New Hampshire, South Carolina, Tennessee, and Washington facilitated administration of State forests. Iowa financed State forest acquisition and participation in emergency conservation activities. Arkansas allocated its severance tax on timber to the forestry fund.

Wisconsin increased its State tax for financing forestry work. Connecticut and Pennsylvania reenacted and amended laws relating to reimbursement of the Federal Government from direct profits from C. C. C. projects.

That enabling creation or extension of national forests.—Georgia authorized purchases for national forests in certain additional counties. New Mexico, in addition to authorizing such purchases, recommended that all Federal timberlands within the State be administered on a sustained yield basis. Tennessee added the requirement that the State forests as well as the Governor must approve Federal purchases for national forest, park, or certain other purposes. Illinois, Minnesota, Oklahoma, Oregon, South Dakota, and Washington authorized exchanges of land between State, county, and Federal Governments. Oklahoma authorized conveyance of specific areas to the Federal Government.

That affecting disposal of State forest resources.—Illinois authorized sale of planting stock not required for State forests, under terms enabling the State to get cooperation under section 4, Clarke-McNary law. Nevada prohibits taking trees, flowers, and shrubs without permission. Minnesota and Washington placed traffic in Christmas trees under license control, with tax of 1 cent per tree in Washington and 2 cents in Minnesota. Wisconsin imposed a penalty for failure to give notice of intent to cut Christmas trees. Colorado authorized sale of timber on State lands, with logging under approved forestry practices. Minnesota provided for clearing and cultural treatment of roadsides.

That regulating cutting on private lands.—Idaho provided for cooperative sustained yield districts, established rules of forest practice for different forest types and age classes, and granted exemption from taxation to young growth and seed trees left for conservation purposes after logging. Tennessee authorized establishment of cooperative sustained yield units composed of privately and/or publicly owned forest lands.

That affecting taxation of forest lands.—Alabama extended tax exemption to capital stock of domestic corporations represented by standing-timber values on their classified forest lands. South Dakota and North Dakota amended and reenacted tree-bounty laws. Wisconsin modified its general tax law relating to exemption of farm woodlands and slope lands, and its forest-crop law in relation to village and county forests. New Mexico imposed a severance tax on the value of timber cut. Connecticut provided for grants to towns in lieu of taxes on lands leased by the State for forest and park purposes.

That affecting forest-fire protection.—Utah created a State Board of Fire Control, provided for fire districts, declared uncontrolled fires a nuisance. Nevada provided for county fire-patrol districts. Oregon authorized county committees to classify forest land, with special provisions about clearing and burning. South Carolina provided for forest-fire control districts in Lee, Greenville, Colleton, and Marion Counties, and for annual payments by counties to the State for the work. North Carolina added Roanoke Island Fire District to its fire-control system. Washington provided more specific authority to employ and suspend fire wardens, and extended their authority. Georgia authorized wardens to enforce State fire laws.

Oregon extended its closed fire season by 3 months. Washington authorized the Governor to proclaim a fire season different from that stated in the existing law, and to close logging, land clearing, and other industrial operations in extreme hazards. North Carolina established a closed fire season with permit system from April 1 to June 15, applicable to organized protected areas only. Indiana makes a permit necessary for burning within $\frac{1}{2}$ mile of any land acquired by the United States. Utah authorized its chief warden to declare a closed fire season when conditions demand. Georgia authorized fixing a period during which woods may be burned over in a period not to exceed 30 days in any calendar year. Connecticut modified restrictions requiring permits for kindling fires in the open. Minnesota authorized closing roads and trails built by the division of forestry and not intended for public highways, when necessary for fire prevention. Utah's chief warden may close areas to all forms of use in emergency. The Governor of Illinois may close definite areas to persons making open fires, except under permit.

Oklahoma, South Dakota, Wyoming, Utah, and Wisconsin prohibited the dropping of cigarettes or other burning material under specified conditions. Wisconsin, Utah, and Oklahoma made willful and malicious setting of fire a felony. Georgia made uncontrolled fire a public nuisance and provided that in case responsible parties refused or neglected to control and extinguish them, organized fire suppression forces might do so and recover costs. Washington strengthened its laws relating to spark arresters, and responsibility of timber operators. South Dakota amended two code sections defining the responsibility for and control of prairie and other fires. Alabama provided that an informant making affidavit of violation of chapter 142, 1923 code—relating to forests and woods burning—be paid one-half the fine up to \$25. Oklahoma improved its forest-fire laws, and Idaho strengthened its slash-disposal law.

That affecting forestry within soil-conservation districts.—Compulsory preventive and control measures relating to forest practice when essential to soil conservation may be invoked under the standard State soil conservation district law as prepared by the United States Department of Agriculture. Such a law was adopted, entire or in modified form, by 22

States as follows: Arkansas, Colorado, Florida, Georgia, Indiana, Kansas, Maryland, Minnesota, Nebraska, Nevada, New Jersey, New Mexico, North Carolina, North Dakota, Oklahoma, South Carolina, South Dakota, Utah, Illinois, Michigan, Pennsylvania, and Wisconsin.

Cooperation in protecting State and private forest lands from fire.—Seventy-six percent of our forest land is so situated that it needs organized protection from fire. During the calendar year 1936, almost three-fifths of this area was under some form of organized protection. This is 9,662,400 acres more than in 1935. A total of \$4,778,544.73 in State and private funds was expended on this cooperative forest-fire protection work in 1936. Other undetermined sums were spent by private owners acting independently. Cooperative expenditures for fire protection under the Clarke-McNary Act are summarized in table 17.

The area of State and private forest land reported burned over during the year was 42,782,420 acres. More than nine-tenths was outside organized protection units; less than one-tenth within them. Of protected area burned, 2,698,050 acres were classed as having productive values. Number of fires reported on protected areas was 73,709, an increase of 19,117, due largely to unfavorable weather conditions and increased recreational use.

The C. C. C. made real contributions to fire protection on State and private forest lands, constructing on them 25,350 miles of telephone line, 37,147 miles of firebreaks, 41,922 miles of trails and truck trails, 500 lookout towers, and 651 lookout houses to March 1937.

Total funds from all sources budgeted for the fiscal year for fire protection on State and private forest lands was \$7,083,306. This was nearly \$1,000,000 more than for the previous fiscal year, yet 175,000,000 acres still lack adequately organized fire protection. Analysis indicates that reasonably adequate protection for all the 427,000,000 acres of State and private forest land that should have it may require approximately \$18,000,000. Appropriations for State cooperation, 1936-38, are given in table 16.

Cooperation with States in tree planting.—The calendar year 1936 witnessed the largest number of trees ever produced and distributed by States for planting by private landowners under section 4 of the Clarke-McNary law. Total, 35,647,809 trees, was an increase of 37 percent over the previous year, and 6,500,000 trees more than during any previous similar period. In addition to improving existing stands, about 36,000 acres were added to woodlands and forest plantations on farms during the year. In all, 40 States and 2 Territories cooperated. For distribution of expenditures, see table 17.

Farm forestry.—On May 18, 1937, President Roosevelt signed the Cooperative Farm Forestry Act (Public, No. 95, 75th Cong.). Coming as a result of widespread interest from rural areas generally, carrying an annual authorization of \$2,500,000, and authorizing cooperation in the development of farm forestry in States and Territories, this legislation should give real impetus to forestry on farm wood lots now owned by more than 2,500,000 farmers. The bill provides for such specific activities as growing and procuring tree and shrub planting stock for reforestation and afforestation; advising farmers on protection and management of forests and on harvesting, utilizing, and marketing the products thereof; and investigations in farm forestry. Basic cooperative policies have already been discussed with the Extension Service, the State foresters, and other agencies.

Several farm-forestry projects in addition to normal cooperative work under section 5 of the Clarke-McNary law were conducted during the year. Timber inventory for a cooperative farm woodland project on either side of the Vermont-New Hampshire line was nearly completed. A similar project was started in south-central New York. Preliminary reconnaissances were made of areas suitable for cooperative marketing in Massachusetts, Pennsylvania, Virginia, and West Virginia. In Mississippi an extensive report was completed on sustained yield possibilities of an area of 2½ million acres of mixed ownership involving a high proportion of farm woods centering around a large wood-using plant.

Rural prosperity in the South is closely associated with forest practices by the pulp and paper industry, which gets much of its current forest needs from open-market purchases from farm woodlands. There is real need for better forest practices to protect these woodlands and to assure to farmers continuous yields at fair prices. For further discussion of this situation see pages 13 and 28.

Cooperative arrangements have been made with the Extension Service and the C. C. C. by which demonstrations of thinning and stand-improvement practices can be accomplished on areas not exceeding 5 acres each. The objective is visual presentation of better woodland practices and integrated utilization providing pulpwood, fuel wood, poles, piling, and quality sawlogs.

Technical advice on forestry practices was given the A. A. A. in connection with that part of the agricultural conservation program having to do with benefit payments for approved forestry practices.

Cooperation with States in farm-forestry extension.—Activities in cooperative farm-forestry extension authorized by section 5 of the Clarke-McNary law are conducted as part of the extension program of the various State agricultural colleges, and are administered by the Extension Service. The Forest Service gives cooperation and technical assistance. During 1936, 36 States and 1 Territory participated. Forty-six forestry specialists are employed in field work. Field demonstrations and meetings during the year totaled 11,543,

a 34-percent increase over the previous year. Expenditures for the fiscal year were \$48,323.51 of Federal funds (Clarke-McNary) and \$103,730.12 of State funds.

A Nation-wide system of State forests.—No appropriation was made under the Fulmer Act (49 Stat. 963) for the fiscal year. In cooperation with States the Forest Service continued, however, to develop a program so that acquisition of land suitable for State forests may proceed without delay when funds are made available.

When the Fulmer Act was first enacted few States were qualified under its provisions. Thirty-six States now appear to be qualified, and prompt application for cooperation may be expected as soon as funds are available. The list includes: Alabama, Arkansas, California, Connecticut, Delaware, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, Montana, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, Washington, West Virginia, and Wisconsin. Areas specifically proposed for State forests under the Fulmer Act were cooperatively examined in 14 States—Arkansas, Connecticut, Florida, Louisiana, Maryland, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Tennessee, Texas, Vermont, and Virginia. Complete reports were prepared in each case. The net purchasable area covered was 8,042,047 acres. Examinations and reports in cooperation with other States are now being made.

PRIVATE FORESTRY

Private owners, with more than 380 of the nearly 400 million acres of their commercial forest lands still without adequate forest management, hold the key to our forest situation.

In helping solve this problem the Forest Service has (1) studied individual ownerships and combination of ownerships, both private and public; (2) cooperated with States and organized groups of forest industries; (3) analyzed factors affecting the success or failure of private forestry; (4) made extensive surveys of political units; and (5) explored aspects of State and Federal legislation affecting forestry practices by private owners. The underlying purpose has been to promote better forest practices, including sustained yield.

In all, more than 50 case studies have been made, largely in the South, the Lake States, and on the Pacific coast. Sixteen more are under way. These studies are followed by conferences with interested parties, and by field demonstrations. As a result, some private concerns have revised their cutting budgets and methods of cutting to bring them more nearly in line with the potential capacity of their lands for sustained production. Preliminary survey of forest practices on industrially owned forest lands indicates that only 3 percent of those lands is now managed on a sustained-yield basis. An additional 7 percent is now being left in good growing condition after logging.

The lumber industry.—It will be remembered that in 1934, under a National Industrial Recovery Act code, the lumber industry committed itself "to conserve forest resources and bring about sustained production thereof." After a conference of industry and public agencies called by the Secretary of Agriculture, regional rules of minimum woods practices were adopted and accepted, with administration by organized industry. The President appointed the Chief of the Forest Service as one of three nonvoting members of the code authority. Through a skeleton organization, the Forest Service then provided for cooperative inspection of woods operations, and technical advice in enforcement of woods-practice rules in connection with code forestry requirements which, effective June 1, 1934, were terminated when all codes were abolished on May 27, 1935.

In April 1937 the organized lumber industry held a conference to review its woods practices, recommend such further developments in them as might seem desirable and practicable, review public activities and legislation in forest conservation, and recommend public action that might support and give effect to industry's program.

Purely in an advisory capacity, but as an interested public agency, the Forest Service attended this conference. By request it submitted comments on woods rules and practices then in effect by industry. It also subscribed to industry's forest-practice objectives as there stated, questioned the possibility of attaining them through purely voluntary action, and suggested the program outlined on pages 6-8. Public regulation, with responsible local representation and provision for appeals, and always kept within the typically American democratic pattern, was one of the three points suggested.

Paper, prosperity, and the South.—From 1926 to 1936 the annual consumption of sulphate pulp in the United States increased from some 900,000 tons to 2,500,000 tons—more than 170 percent. From 1935 to 1936 the increase was approximately 20 percent. In 1925, 43 percent of the domestic sulphate pulp consumed was imported, but by 1936 imports had dropped to 29 percent. Indications are that there may be available by 1938 some 3,660,000 tons of sulphate pulp annually, or 50 percent more than the estimated consumption in 1936.

In the South, 13 new pulp and paper mills with plant investments of around \$100,000,000 and planned annual capacities of about 1,500,000 tons of pulp are now projected for early

production. This requires some 2,500,000 cords of wood a year. Reasons for this concentration are relatively cheap labor, deep-water shipping facilities, and a plentiful supply of wood at relatively low costs.

Certain companies own or control some forest land, but they rely largely upon pulpwood secured principally from farmers. Transportation costs ordinarily confine wood supplies to an area not more than 150 to 200 miles from any given plant. In about half the South there are extensive areas where existing industries are already using more wood than is replaced by annual growth each year. This eats into assets needed to keep forests productive. Superimposing new pulp and paper plants upon already established industries means that without some form of intelligent management certain areas may be left in unproductive condition for generations.

Such a situation is neither in the public interest nor that of wood-using industries. A friendly warning has been issued. The picture is admittedly complicated, involving many factors such as an intricate pattern of forest-land ownership, thousands of wood-using plants with varied requirements and national and world-wide markets, and huge forest areas that have already been exploited. State foresters and the Forest Service are cooperating with individuals and groups. The American Pulpwood Association has suggested minimum woods-practice rules. If applied to all lands from which pulpwood may be secured, these rules may prevent the suicidal practice of clear cutting, and in that respect may be counted as some advance. But as now constituted, these rules fall far short of the association's announced objective of building up forest growing stock, which is the crux of the situation.

Prairie States forestry project.—Up to June 30, 1936, 1,277.8 miles of shelterbelt strips had been set out, 6,474 acres of farmstead plantings established, 23,771,061 trees, cuttings, and nuts planted. Average survival was 81 percent. On that date there were also 75,000,000 seedlings growing in nurseries, an insistent demand for them, a pressing problem of work relief for drought-stricken families, and only \$170,000 made available by Congress for liquidation purposes. With emergency funds from the W. P. A., 18,246 man-months of employment were given during the fiscal year to needy local citizens on relief rolls, and carry-over nursery stock was used. This saved heavy investments already made.

Cooperative agreements executed this year required larger contributions by the landowner than in the past, yet there was a greater demand for nursery stock than could possibly be supplied. This was due, perhaps, to those living windbreaks which tell a story that cannot be refuted. In addition to the stock planted (table 18), this project furnished nearly 9 million seedlings to other Government agencies during the current year.

Naval stores conservation program.—In 1936 and again in 1937 the Forest Service was assigned by the A. A. A. with responsibility for technical performance standards and field inspections required in the naval stores conservation program authorized by the Soil Conservation and Domestic Allotment Act. The work was localized in the South, where production of naval stores for world markets is centered.

The 1936 program was announced in July, when producers were in midseason operation. It provided primarily for discontinuance of faces on small-sized trees, and other uneconomic faces, with maximum discontinuance on any one turpentine place or farm of 25 percent of all operating faces. Fire protection and good chipping practices were also required.

For the calendar year 1936, 921 operators filled in work sheets listing 78,627,209 operable faces. Of these, 14,286,678 were listed for withdrawal from production under terms of the program, and final payment was made on 13,553,321 faces so withdrawn.

The 1937 program, conducted on a calendar-year basis, was announced in December 1936. This was before most producers had started 1937 operations. For that calendar year, work sheets were filed by 1,060 operators representing about one-third of all estimated operating faces. This was only approximately 60 percent of the anticipated participation. The number of faces listed on 1937 work sheets was 49,711,020. Of these, 1,898,567 were to be withdrawn from production under terms of the program. Final payments have not yet been made.

Research

To be permanent and to contribute regular net returns in service, money, or both, forest-land management must rest on sound technical and economic bases. This applies to public and private ownership alike. Recognition of it is evidenced by increasing demands for information based on forest research. Existing knowledge, however, falls short in many cases of what is really needed adequately to guide policies, programs, and action.

FOREST ECONOMICS

Research in forest economics serves both public and private needs. Land management is invariably confronted with the responsibility of equitable disposal and use of forest-land products and privileges. For more than three decades the Forest Service has adhered to the policy, on national forests, of multiple-use land and resource management. In the words of a former Secretary of Agriculture, it has consistently held that "forests are to be devoted to their most productive use for the permanent good of the whole people, and not for the temporary benefit of individuals or companies."

Prescriptive rights.—From time to time national-forest users want irrevocable rights to certain uses, such as grazing. Stabilization of business is the argument usually advanced. A study of experiences in older countries, where vested rights have been granted, indicates that grazing and other uses have a legitimate place in balanced multiple use of forest land, but only if they are kept under control by the owner or agency responsible for forest-land management.

Existence of such rights, however innocuous at the start, has almost without exception become a serious impediment to efficient forest management. In many countries it has led to destruction or impairment of the productive capacity of forest lands. Where such rights are established, most countries have to go through long and costly adjustments to safeguard public interests. In almost every case, establishment of prescriptive rights to forest lands has been economically and socially undesirable. The conclusion is inescapable that they make it impossible to adapt many forest-land uses to changing needs of dependent communities, forests, and users. A report on this study, particularly as it bears on our own future policy, is in press.

Land utilization.—In broader phases of land economics, studies of forest-land ownership and use, and of tax delinquency and reversion of ownership, provide guidance for public acquisition programs. In the Douglas fir region such studies are now assisting State and county officials in preparing policy to govern use and disposition of tax-forfeited forest lands.

Land-utilization studies in cooperation with the Giannini Foundation were continued in California's Sierra foothill counties. Results are being used by State and Federal planning agencies. To be successful, solution of the problem must help stabilize tributary community life dependent on permanent resource management. On private and public lands involving coordinated use for agriculture, range, and forest production, it must also correlate uses. Crystallization of such plans inevitably raises the question whether private ownership of forest and wild lands will recognize and redeem its public responsibilities, or whether public ownership of certain areas is necessary adequately to protect public interests.

In the Lake States compilation of tax-delinquent areas was continued and some correlation of tax forfeiture and the kind of land involved was made. Here are some 12 to 15 million acres of "no-man's land" that, interspersed with State and Federal holdings, urgently need rehabilitation as part and parcel of a public acquisition program. Study in the Yazoo Delta of the Mississippi indicates that heavy drainage and land taxes are a stumbling block to private ownership there.

Forest-fire insurance.—Forest-fire insurance is practicable in the Northeast and is a feasible commercial undertaking with proper observance of underwriting principles. A bulletin giving results of an intensive forest-fire study in the Pacific Northwest is now contributing toward the development of forest-fire insurance.

Timber management.—Economic studies of timber management in the Douglas fir region involve such problems as investment requirements for an adequate growing stock under sustained-yield management. So far, it appears that about one-third the existing growing stock has no present realizable commercial value and hence involves no investment

burden; one-third is of low value and on current valuation justifies only small investment burdens; one-third or less is of such high investment value as to create pressure for immediate liquidation.

Ponderosa pine studies have led to decided changes in logging on public lands. These changes provide for removal of only 30 to 40 percent of the volume during the first cut, as compared to 60 to 80 percent under former practice. An important factor facilitating this procedure is the revolutionary change from railroads and skidders to truck and tractor logging.

With studies to demonstrate the economic feasibility of light cuts at short intervals in stands of virgin and second-growth shortleaf and loblolly pine, the possibility of integrated utilization has also been investigated. Results, where a private company follows the plan of light cuts, sends better quality logs to the sawmill, poorer ones and low-quality material from tops, limbs, and thinnings to the pulp mill, indicate (1) better returns than under clear cutting and (2) an opportunity to build up depleted forest growing stock. Such modifications will yield benefits in community stabilization, and larger continuous economic and social returns from the forest. With truck transportation, light cuts of only 500 board feet per acre cost practically the same per thousand as when 4,000 board feet is removed.

Pulpwood.—If pulpwood requirements are supplied so far as possible from stands handled under light cuts, with integrated utilization of the timber removed and coordination with the needs of existing timber-using industries, investigations show that planned pulp expansion in the South can be a constructive economic force in bringing closer utilization and improved forest practices. Production-cost work shows that low-quality material from poor trees and tops is acceptable for pulpwood, and can be handled at a price to yield a fair margin for profit and stumpage.

Forest taxation.—Advisory service was continued to States interested in application of sound principles of forest taxation. Major effort was given to a study of what can be done to improve fiscal arrangements between Federal and local governments in approximately 500 counties where national forests are located.

As partial reimbursement for loss of revenue due to tax-exempt status of national-forest lands, local governments are now granted money payments of 25 percent of the gross receipts from these properties. Local governments also benefit from national-forest activities involving construction of local roads, and through stabilization of local industries dependent on national-forest resources. The 25-percent contribution has, however, been found unsatisfactory in some respects.

Comprehensive study of this problem resulted in formulation of two alternative plans. Both have the following objectives: (1) To stabilize contributions on account of national forests created from the public domain, and to distribute such contributions more equitably without making any marked change from the aggregate amount now allowable by law in each State; (2) to provide adequate annual contributions to taxing districts containing those acquired national forests from which realization of substantial receipts will inevitably be delayed either because the lands had been cut over before acquisition, or because cutting in the early future would be contrary to sound public policy.

The Forest Survey.—The task of rapidly covering and reporting on three-fifths of a billion acres of forest land is a big one. With the help of emergency funds, the Forest Survey made tangible progress in field work within six regions during the year. Less headway was possible in office work.

Field work covering 51 million acres was completed for the Pacific Northwest. About 2,000 copies of detailed forest-type maps covering Oregon and Washington (except the northeast quarter of the former) have been lithographed. A report for the Douglas fir region is nearing completion. Preliminary reports for 14 counties in the Oregon-Washington pine region were issued. In the Douglas fir region forest increment is at least twice that previously expected; and total volume of timber is about equal to previous estimates.

The northern Rocky Mountain area includes some 37 million acres. It is closely allied in regional planning with the Pacific Northwest. About 50 percent of it has now been mapped and inventoried. Absence of satisfactory growth figures required preparation of normal yield tables for the larch-Douglas fir type, and collection of stocking information to adjust existing white pine and ponderosa pine tables to average stand conditions. Work is nearest completion in northern Idaho and northeastern Washington. Two preliminary county reports for northeastern Washington have been issued. For the area studied, type maps have been prepared. Regional cutting depletion compilation has been finished, and additional information compiled on requirements for farm buildings, fuel wood, and fence posts.

In California 29 out of a total of 72 million acres have been type-mapped in the field, 10 vegetation-type quadrangles have been lithographed, and 12 more are about half completed. Type maps are of immediate value in planning fire control, and recreational and utilization improvements. They will be indispensable to the inventory phase of the survey.

Forest survey field work in the Lake States is now virtually completed. Office computations and analyses are not far behind. A publication for Minnesota is in preparation, as are generalized forest type maps for timbered parts of Minnesota, Michigan, and Wisconsin.

Preliminary estimates indicate some 50 percent more timber volume in Minnesota and Michigan than previously supposed. A good part of this is scattered, of minor species, and economically unavailable. Virgin timber is limited, and local shortage seems inevitable during the next few decades. The big problem here is to husband what is left until second growth reaches maturity. Data show growth several times larger than previous estimates. Some must be reserved to build up depleted growing stocks, so not all of it is available for cutting.

Field work in the Appalachian territory was initiated this year on a fully organized basis. Some 26 million acres—or one-third the territory's total forest area—has been cruised. Growth and depletion studies are just getting started. A progress report for the Tennessee Valley Authority, concerning Norris Dam watershed, and a release for part of South Carolina, have been issued.

In the South, effort was focused upon compilation, analysis, and interpretation of the enormous volume of forest information already collected for the 129 million acres studied. Six preliminary reports were issued. Additional forest information was supplied many public and private agencies and individuals. Much of this was in connection with pulp-mill expansion. On an area basis, preliminary figures for 83 million acres indicate 6 percent of virgin timber; 49 percent of old growth partly cut and second growth of sawlog size; 30 percent of second growth below sawlog size; 5 percent of reproduction; and 10 percent of nonrestocked and scrub hardwoods. More than three-fourths of the forest area, and nearly three-fifths of the timber volume, are second growth. Forest stocking is below normal, and a part of the current growth must be retained annually if depleted forests are to be built up.

Present and future requirements for timber have now been studied for all major classes of wood use. The next step is to analyze probable national requirements and trends on the basis of information collected. It seems probable, for example, that due in large part to submaintenance during the past half decade, farm demand for lumber may exceed 6 billion board feet annually. Wood is still the leading material in residential construction, but use of it in automobiles and refrigerators has dropped sharply. In furniture, wood is more than holding its own. Declining demand for naval stores has brought an excess supply of turpentine, a situation that must be changed if the naval-stores industry is to prosper, and an improved market for charcoal is a critical need of the hardwood distillation industry.

FOREST AND RANGE INFLUENCES

Influences research is under way at seven regional forest experiment stations. At four—California, Intermountain, Southwestern, and Appalachian—material progress has been made on primary installations in an intensive study of the effect of cover on water. The Southern Forest Experiment Station has just begun a similar study in the Ouachita National Forest. It promises to be an interesting development because of the high rainfall, steep slopes, and shallow soils which are responsible for an exceedingly rapid rate of run-off, and which cause the region to make a big contribution to flood waters of the lower Mississippi.

Floods.—The Ohio River flood of January 1937 points again to the need for similar studies in the Ohio Basin, especially at headwaters of the Allegheny River and on streams originating in the Cumberland Plateau and the Ozarks of southern Missouri.

Evidence accumulates on values of the forest as a protective cover in times of flood. Observations in southern Ohio of numerous pits, dug shortly after heavy January rains, show field soils at depths below 2 and 3 feet drier than surface soils. In contrast, forest soils up to 5 feet in depth contained as much or more water than did surface soils. This demonstrated again the greater absorptive capacity of forest soils.

Storm flow.—Storm flow from three small watersheds in western North Carolina illustrates the effect of misuse of land on run-off. Data for three summer and fall storms in 1936 show that, in percentages of precipitation, abandoned agricultural land has 2 to 10 times more storm flow than nearby forested land. Storm flow from eroded pasture land was from $3\frac{1}{2}$ to 13 times as great as that from nearby forested land. Other data for 15 storms of approximately 2 inches showed maximum run-off from nonforest watersheds to be from 10 to 20 times greater than from forested ones.

Wind breaks.—Prairie States tree-planting investigations demonstrate that windbreaks reduce wind velocity by as much as 10 percent on the leeward side of the break for a distance of about 25 times the height of the trees. This reduction in velocity is especially valuable in protecting the region's highly erodible sandy soils. Windbreaks, especially those with conifers, also effect savings of 30 to 50 percent in the amount of fuel used in maintaining nearby favorable indoor winter temperatures. Indicators point to the wisdom of using narrow rather than wide windbreaks.

FOREST-MANAGEMENT INVESTIGATIONS

Successful management of forest resources plays an essential part in rural and industrial economy. This has focused attention on methods of handling forests. It has also accentuated the need for new and improved practices. Numerous investigations in regenerating forests, in protecting them from fire, and in tending and harvesting forest stands, contributed to this need.

Planting, timber-stand improvement, and fire-control practices developed and improved by research continued to provide the bases for large-scale employment of local and C. C. C. labor. Wider adoption of improved naval stores practices, aided by the naval stores conservation program under the amended Soil Conservation Act, served to further emphasize the value of naval stores research.

Planting and silvicultural.—Information on seed, nursery, and planting technique has been made available to prairie States planting work. It was found, for example, that seedlings subjected to periodic dryness were more drought-resistant than those watered copiously and continuously, and that within limits the larger the seedlings the better the survival after planting in the field. It was also determined that high surface soil temperatures are often a cause of high mortality, and that the source of seed is directly related to the seedling's resistance to cold and drought. Subsoiling in preparing sites for planting increased survival. Methods of hastening germination of seeds involving both chemical and mechanical means were developed. Such studies aid materially in selecting drought-hardy and long-lived species, and in providing planting technique to insure better survival in farm wood-lot and shelterbelt planting.

A successful method was developed for long-leaf pine seed storage. In the nursery it was found that shading and root pruning in place under central-Louisiana conditions do not ordinarily improve field survival, that beds should be thinned to light uniform densities, and that low tree percentage is more likely traceable to the condition of the seed before sowing than to factors in the nursery. Planting studies showed that field survivals are markedly improved by not pruning roots to less than 6 inches, by setting seedlings at proper depths, by exercising care not to strip the rootlets or storing too long in heel-in beds or in water.

Advances were made in designing machinery and equipment to aid investigations and improve practices in seed and planting work. The Lake States station developed a new drought machine to test large numbers of plants under controlled conditions. This machine speeds up the process of selecting and developing drought-resistant plants suitable for prairie plains States. A machine for scarifying black locust seeds facilitates handling large quantities of seed now used extensively in planting for erosion control, and in farm wood lots for fence posts. The southern station designed simple devices for testing the maturity of southern pine cones based on specific gravity of the immersed cone.

Reforestation by direct sowing of seed instead of by planting nursery seedlings still holds promise in several important forest types. The necessity of protecting newly sown seeds and young seedlings from birds and rodents has been emphasized by studies in many sections of the country.

Studies of cutting methods to insure natural regeneration were continued. Western white pine trees of good vigor are essential if adequate seed is to be produced using methods depending upon clear cutting with seed trees. In the South it was learned that ground cover greatly affects the ability of the large-winged seed to reach the soil. This suggested removal of this barrier during the regenerating period. Light grass interferes least, oak litter next, and heavy pine litter most. Once seed has reached mineral soil, losses due to birds are affected in reverse order. Studies in the northeast spruce type reveal that stands easily regenerated depend for successful management mainly on protection for advance reproduction against logging damage, wind-throw, fire, and excessive shade and competition from hardwoods. Stands difficult to regenerate also require a light initial cut that removes one-fourth to one-half of the stand in order to permit reproduction. The remaining overstory should be removed after 10 to 15 years.

Selective types of cutting continued to be tested. It was found feasible in the redwoods to substitute selective-cutting methods (using tractors) for former heavy cuts where destructive slack-line yarding and heavy high-lead equipment were used. The best silvicultural practice for northern hardwoods involves partial cutting to remove about 30 percent of the stand. Success of light frequent cutting in ponderosa pine in the Northwest has been demonstrated on a large scale.

Forest genetics.—A comprehensive summary has been made of previous genetics studies. Ample evidence seems to have been accumulated to prove that seed from the locality in which it is to be planted is usually superior to that collected outside. Analysis of 20 years' test of Douglas fir plantations for which seedlings from known geographic seed sources were used showed differences in time of bud bursting, susceptibility to frost injury, and in height growth. All were in favor of the local seed. The same conclusion was drawn from tests of ponderosa pine in the northern Rocky Mountains, the Northwest, and in the

Rocky Mountain regions. In the latter region Douglas fir and lodgepole pine also showed similar results. Louisiana loblolly pine seed proved superior to Texas, Arkansas, and Georgia seed for plantations in Louisiana.

Another promising line of development is found in the new tree varieties that offer possibilities of superior pulping quality, more rapid growth, and increased resistance to disease, insects, drought, and low temperatures.

Fire, naval stores, and related investigations.—Research on forest-fire protection provided additional basis for improved fire-control technique, increased knowledge of the influence of various factors on fire behavior, and determined some important effects of fire on stand mortality, growth, reproduction, and soil conditions. In the work on fire control, improved methods for organization and detection planning were worked out for application by administrative agencies in California and the northern Rocky Mountains. Methods of fire-danger measurement continued to be improved by detailed studies of fuels and of individual factors affecting fire behavior. Substantial progress was made in integrating factors of fire behavior, fuel hazards, and visibility for improved fire-control planning.

Studies of soil on burned and unburned areas in the long-leaf pine belt yielded information on their chemical and physical properties. Burned-over soils are characterized by a slightly higher replaceable calcium content and a higher degree of compactness, and for the most part support an herbaceous vegetation in the typically open stands. In this connection it was determined that heat from forest fires in the longleaf pine type is ordinarily insufficient in itself to cause soil deterioration.

Naval stores studies gave several promising results. Preliminary tests indicated a 45-percent increase in gum yield of longleaf by the use of a 1-inch height of streak, followed by application of commercial hydrochloric acid to the freshened wound. Loss of gum from cups through rain washing was found to be negligible. Frequent dipping of cups did not conserve the turpentine content of the gum collected, but the practice may be desirable to prevent wastage from overfull or leaking equipment. Dry-facing following a severe fire is variable. In some cases it may require jump streaks of 1 to 12 inches when chipping is resumed.

For years there has been a feeling among naval stores men that the vigorous healing bars between faces were extra rich in resin. This belief has probably contributed greatly to mortality from excessive turpentinizing. Studies indicate that 4-inch bark bars between faces are desirable, and that gum yields from narrow faces placed on rapidly healing trees usually classed as worked-out ones were not much superior to those from faces of similar size on the usual back-faced tree.

A study of second-growth stands of loblolly, pure or mixed with hardwoods, by the Appalachian Forest Experiment Station contributed significant results in providing useful tables and in developing an improved method of predicting yield. The new method gives values which may be termed "empirical" as contrasted with the "theoretical" yields of normal tables attainable only with fully stocked stands. These new tables are more accurate than estimates derived by applying correction factors to normal tables. They can be applied by forest managers with a minimum of technical training.

As a byproduct of the work on yield of loblolly pine, additional light was shed on the relation of stand density to height growth of trees. It was found, for instance, that when density is expressed as a relation of number of trees per acre with average diameter, optimum height growth occurs within a comparatively narrow range of density. Also that both overstocking and understocking reduce heights attained for a given age and site quality. Since height growth has usually been considered solely a function of site quality, these results, by defining the extent to which it is affected by density, point the way toward more accurate appraisal of the productivity of forest areas. The more precise measurement of the influence of density on height, moreover, has value as a guide to thinning practices.

In view of the growing importance of partial cutting, the results of analysis of records covering 20 years' growth in selectively cut mixed conifer stands in California have more than local interest. One striking fact brought out is that the species falls into two groups, with significant differences between but not within the groups. Sugar pine and white fir grew at essentially the same rate, and faster than ponderosa pine, Douglas fir, and incense cedar. By taking into account factors of reserve volume per acre, site index, average volume per tree, percentage of volume in sugar pine and white fir, it is possible to estimate growth of selectively cut stands in the type within 10 percent of the actual mean on comparatively small areas. This degree of accuracy has not been possible heretofore. Closer control of cutting budgets through more accurate forecasts of growth is a major factor in sustained-yield operations.

RANGE RESEARCH

Study of range forage utilization standards, initiated in all western regions, aims to formulate practical "yardsticks" for describing approved grazing practices, and simple

usable methods of measuring utilization. Basic objectives are most efficient use of range-land resources, including forage for livestock and wildlife; watershed protection; recreation; timber production; in short, permanent protection of human benefits dependent upon the range. Leading to a program of fundamental research to be conducted by the experiment stations, immediate efforts will concentrate on analysis of existing information with emphasis on national-forest ranges.

Range management.—Studies on semidesert ranges by the Southwestern station aim to maintain forage and livestock production under adverse conditions. After 20 years, the Jornada and Santa Rita experimental ranges in southern New Mexico and Arizona stack up with similar heavily stocked unregulated ranges of potentially equal productivity in part as follows: Grazing capacity on managed range is double that of outside range; net calf production is more than half again larger; death losses are two-thirds lower. Conservatively grazed ranges have maintained forage productivity better, and in some instances improved faster than ungrazed areas. Conservative grazing assures adequate range feed year after year, and minimizes supplemental feeding. Stocking the range 20 to 25 percent below average forage yield provides assurance against recurring drought and protects forage and livestock production. This is vital, since an abundance of cheap range forage is essential.

Similar studies by the Intermountain station show that if a range is stocked on the basis of average forage production or above, as often occurs, the stockman is in difficulty about half the years unless he offsets range-feed shortage with supplemental feed, which increases cost. On Utah mountain ranges, stocking approximately 20 percent below average forage production is found to be wise practice.

Forage values.—Studies of forage grazed on pine ranges by the California station show that early in the season the six species grazed most often, in order of importance, are sedge, hawkweed, mountain brome (*Bromus carinatus*), squirreltail grass, tarweed, and dandelion. But later in the season they were lupine, downy chess (*B. tectorum*), bitterweed, Idaho fescue, squirreltail grass, and sedge. Most surprising is the ranking of downy chess in second place late in the season. This was in spite of abundant other species commonly regarded as having better forage value. Average daily gain of fifteen 2-year-old steers ranged from 4.4 pounds the first 2 weeks of the grazing season, beginning in mid June, to 1.9 pounds for the period ended August 15. Total average gain for the season was 189 pounds. This average rate of nearly 2 pounds per day was a surprisingly high value for cut-over-pine cattle ranges.

Reseeding.—Artificial reseeding tests in central Utah foothills by the Intermountain station showed that smooth brome, after 5 years, increased the grazing capacity ninefold. Native mountain brome and crested wheatgrass increased the capacity three to four times. At higher elevations, mountain and smooth bromes and the native slender wheatgrass proved successful whereas crested wheatgrass failed.

In seeking restoration of millions of acres of abandoned farms in the northern Great Plains, encouraging reseeding results in spite of drought have been obtained by the northern Rocky Mountain station. Crested wheatgrass holds promise for eastern Montana. Best and most consistent results were obtained from fall as against spring seeding.

In transplanting experiments on southern New Mexico semidesert ranges, the Southwestern station attained a 50-percent survival of 1935 transplants of black grama, mesa dropseed, paspalum, and four-wing saltbush or chamiza. Where protected from rodents and cattle it is estimated that fully 90 percent of the 1935 transplants are surviving. This increase is due chiefly to improvements in planting technique. Chamiza seeds germinated best when they were barely covered, but paspalum seeds responded best when covered from 1 to 2 inches deep. Paspalum seeds usually germinated from July to September, a period when water was available and soil temperatures were high. Chamiza seeds, in contrast, rarely germinated until late September or October, when ground surfaces had cooled. These results indicate the kind of practical information that must be determined for successful reseeding.

Added studies.—A survey of range conditions and problems by the Rocky Mountain station indicated the urgent need for studies of management of the short-grass plains in eastern Colorado and Wyoming. Accordingly an experimental range was established in Weld County, Colo., in cooperation with the former Resettlement Administration.

During the year range investigations were started by the newly organized field division of range research at the Pacific Northwest station, which serves Oregon and Washington.

FOREST PRODUCTS

Forest-products research, the bulk of which is conducted at the Forest Products Laboratory at Madison, Wis., is concerned with (1) reducing wastes and lowering costs of harvesting, converting, and utilizing the timber crop; (2) insuring to the consumer better service from wood in natural and converted forms; and (3) developing for wood new uses, and through them new social and economic values.

All this is essential in progress toward permanent, prosperous forest communities and productive use of forest lands generally. It is of direct interest to the producer, processor, and the consumer. The farmer has a vital stake in forest-products research for he is, at one and the same time, producer, processor, and consumer. He is also the largest per capita consumer of forest products in the United States and owns, in farm wood lots, more than one-fourth of the Nation's forest land.

Pulp and paper.—This farm ownership is an important factor in the pulp and paper industry, particularly in the South. Pulp and paper investigations have for several years past been directed toward improved utilization of southern and western species. This is because of the immense quantities of potential material available from these woods, and the desirability of more effective use of them. The significance of this program has been made apparent by the recent tremendous growth of the industry, particularly in the South, the resultant interest in the properties of the woods available for pulp, and in methods of handling and converting pulp.

Progress was made during the year in studies of the influence of growth conditions upon the quality of southern pine pulpwood, and previous indications that these conditions are more significant than any differences in species were verified. Studies of the production of newsprint from southern pines also yielded data of interest. The previously suggested method of substituting semibleached sulphate pulp for the sulphite normally used in newsprint was improved. Advances made in methods of handling pine furnish on the paper machine resulted in laboratory-made newsprint papers of the highest quality.

Pulping quality of both Douglas fir and western hemlock was found to be affected by growth conditions. The range of variation was not so marked as in the southern pines, and did not present the problems in operation that were encountered with them. Study of the paper-making properties of Douglas fir pulps, with particular reference to book and mimeograph papers, resulted in methods for securing the opacity, bulk, and ink-absorption properties which were normally lacking in papers made from extremely long-fibered woods.

A systematic investigation of soda-base sulphite pulping was continued. This included use of neutral monosulphite liquors combined with various buffers. Extremely strong, bleachable pulps having excellent possibilities for the manufacture of high-grade strong papers were produced from a wide range of species. In fundamental work on the sulphate and soda processes, the influence of sulphur added to the cooking liquors showed that improvements in yield and strength are marked only in cases where the softwoods are used. Comparison of the mechanical pulping of well-seasoned spruce and aspen showed that the latter, although apparently a softer wood, when ground to the same freeness requires a power consumption 1.5 times that required for spruce.

Chemical composition and utilization of wood.—Chemical conversion of cull and low-grade trees and logging and milling wastes into useful products offers a great potential possibility of economic significance to all timberland owners. During the year plastics formed by the hydrolysis of sawdust were further improved, and were found to afford practical binders for veneer, paper, and other coatings. A new wood plastic was prepared by direct acetylation of wood.

Lignin, the second-largest constituent of wood, was shown by X-ray to be crystalline instead of amorphous, as was previously supposed. The amount of lignin that may be removed from wood by treatment with organic and inorganic solutions was determined. This information establishes one more milestone in the progress toward a better understanding of the chemical composition of wood.

Time required for isolation of holocellulose, the subdivision of wood containing fibrous and sugarlike constituents, was reduced from 2 days to less than 3 hours. This made it a practical analytical method. Rate of leaching of the water-soluble preservative sodium fluoride from wood was shown to be appreciably reduced by the presence of slow-leaching chromates.

Growth, harvesting, and utilization.—With a constantly increasing proportion of second growth in our forests, the problem of improving the quality of timber deserves the consideration given to it. Investigation showed that in pure stands and plantations several more important commercial softwoods will yield only low-grade lumber in rotations of 60 to 80 years, even when fully stocked. A manuscript was prepared on the effect of knots on lumber quality, and on the desirability of artificial pruning to obtain maximum amount of clear wood in the shortest time. Specific-gravity determinations indicated that second-growth oak from the Appalachian Mountain region is not so soft textured as old-growth material. This is due primarily to a more thrifty growth of the second-growth trees. Lumber cut from second-growth southern pine which had made rapid initial growth followed by slower growth later on, was found to warp excessively when both types of wood occurred in the same board. This is accounted for by the unusually high longitudinal shrinkage of wood containing wider growth rings. It can be controlled to some extent by carrying out forest and wood-lot thinnings that will maintain trees at a relatively constant rate of growth.

Studies of diameter limit below which it is unprofitable for farmers and other timber owners to cut trees for sale were completed on second-growth northern white pine and

hardwoods in New England. A study in Southeastern States revealed that cutting trees smaller than 8 inches in diameter for pulpwood is unprofitable, and results in skinning the land. Assistance was given in planning utilization units for the cooperative timber harvesting and marketing project at Cooperstown, N. Y., and for the project of the former Resettlement Administration near Elkins, W. Va. Logging and milling studies were made in Lake and South Atlantic States to provide information needed in the forest survey and in appraisal and acquisition programs of the Forest Service.

New kiln schedules, that make practicable the drying of black gum and other refractory hardwoods green from the saw, were devised. They should aid forest landowners in establishing outlets for many species of wood heretofore considered unprofitable because of seasoning difficulties, and should also aid consumers by reducing freight charges and eliminating rehandling and redrying charges. Progress was made in seasoning large items of Douglas fir and other refractory species with chemicals. Invert sugar, a nonconductor of electricity, continued to give satisfactory results in seasoning cross arms. Blackstrap molasses selling at \$20 a ton was found to be a possible substitute for pure invert sugar selling at 5 cents a pound.

Two additional seed-cone kilns of Forest Products Laboratory design were installed—one on the Chippewa and one on the Manistee National Forest. Proper temperatures and relative humidities for kiln drying northern white pine and jack pine cones in these kilns, with a maximum yield of viable seed, were determined experimentally.

Attention was given to developing less complex methods for treating fence posts and other farm timber with wood preservatives. Good penetration was obtained in lumber and peeled posts by soaking the wood for 2 weeks in a 10-percent solution of zinc chloride or other water-soluble preservative. The greener the material the better the penetration. Complete sapwood treatment was obtained in freshly cut round posts, with the bark on, by allowing zinc chloride solution held in a section of an old automobile inner tube to penetrate, under force of gravity, the end grain of the posts. Although zinc chloride treatment is not so effective as impregnation with creosote, it should make posts of nondurable wood as decay-resistant as most untreated naturally durable posts. The method is inexpensive and generally suitable for water-borne preservatives.

Improved wood construction.—Research was continued on wood as a material for construction of better homes for more people at prices they can afford to pay. Emphasis was placed on low-cost construction, insulation, and fireproofing. Development of a system of prefabricated house construction with plywood-covered wall, floor, and roof units culminated in plans and contracts for the erection of two such houses on the laboratory grounds. Detailed cost data to be kept during fabrication and erection will demonstrate possibilities of this all-wood construction system as a means of providing low-cost housing.

Promising possibilities were also indicated in use of wood in the form of lumber for prefabricated house units. Information was obtained, in fire tests of plywood-faced wall panels, on resistance to fire spread and fire penetration. Plywood glued with phenol-resin glue proved more fireproof and moisture-resistant than plywood glued with less water-resistant glues.

Progress was also made in solving problems arising from modern building methods that cause condensation in walls and attics during cold weather. Vapor barriers of roll or building-paper type were found a practical and economical method of control. Antishrinkage treatments with synthetic resins formed in wood were developed for plywood. These methods increase resistance to passage of moisture, reduce weather checking, and make a smoother and more attractive surface.

Survey was made of good and bad practices in small-house construction. From it a bulletin for prospective home buyers and builders will be prepared. In representative cities in 17 widely separated States, only a few small houses in the \$3,000 to \$6,000 class were found to be consistently poor throughout, although some bad structural features and some newly developed good features were encountered. These should be more widely recognized in current building activities.

Work was begun during the year on a bulletin showing the design, suitability, and economy of laminated or glued-up arches for use in buildings requiring large clear spans. Barn rafters of this construction promise to be cheaper as well as better than types now employed. American-made metal connectors for large structural timbers were found to be equal or superior to foreign-made connectors of the same type.

Painting.—Studies in painting of wood have continued. The main objective is to make satisfactory results in house painting more certain, and reduce painting costs to home owners and farmers. Because of the great number and variety of house paints, frequent introduction of new formulas, and the lack of any system of classification or grading, it is exceedingly difficult to give specific directions for obtaining best painting results. So consumers can be reliably informed, it seems necessary that a practical system of separating paints into classes and types be developed and put into practice. Tentative system of this kind has been devised by the laboratory. It is offered as a first step in the difficult task of bringing order out of present chaotic conditions.

Related investigations.—In addition to leading projects already summarized, certain lesser ones deserve brief mention.

Experiments were conducted on fire-extinguishing effectiveness of more than 200 chemical solutions for use in fighting forest fires. Many solutions showed some superiority over water in direct extinction, and considerable superiority in an indirect attack which pretreats a strip in advance of the fire to act as a line from which to backfire.

An inspection of the 1937 Ohio River flood area confirmed the belief that structural damage to frame buildings by floods can in large measure be prevented by securely anchoring buildings to firm foundations with bolts.

Survey was made of the effect on the employment of labor of recent changes in methods and equipment used in the lumber industry. End result for the lumber industry east of the Rocky Mountains was a slight decrease during the past decade in man-hour requirements per 1,000 board feet of lumber manufactured.

Assistance was rendered the Post Office Department in the identification of wood, glue, and paper retrieved from fatal bombs sent through the mails.

In addition to publications already mentioned, manuscripts were prepared on production of pulpwood in the mid-Atlantic region, design and behavior of lag screws, how the farmer and consumer can use the Forest Products Laboratory, chemical products from forest trees, and the amateur woodworkers' handbook. To help keep the farmer abreast the many forest-products investigations of direct benefit to him, an extensive series of articles was released for publication in State and local farm papers.

New Legislation Affecting the Forest Service

The following Federal legislation affecting the Forest Service was enacted at the first session, Seventy-fifth Congress. For convenience, this record indicates acts passed after as well as before close of the fiscal year.

Appropriation Acts

First deficiency.—Act of February 9, 1937 (Public, No. 4) includes: (1) \$2,045,000 for emergency fire fighting, fiscal year 1937; (2) \$789,000,000 for relief work to June 30, 1937 (total to Forest Service under this and previous similar acts for fiscal year 1937 was \$17,541,349); (3) \$95,000,000, Emergency Conservation Work to June 30, 1937.

Department of Agriculture.—The act of June 29, 1937 (Public, No. 173), making regular appropriations for fiscal year 1938.

Emergency relief.—Act of June 29, 1937 (Public, No. 47), carrying \$1,500,000,000 for fiscal year 1938, with \$4,479,010 project funds and \$175,000 administrative funds (total \$4,654,010), for the Forest Service for July to December 1937, inclusive.

Civilian Conservation Corps.—Act of July 1, 1937 (Public, No. 50), appropriating \$350,000,000 for fiscal year 1938.

Other Acts

Act of May 28, 1937 (Public, No. 95), authorizing cooperation in developing farm forestry in States and Territories, and an annual appropriation not to exceed \$2,500,000 for carrying out the Cooperative Farm Forestry Act. No appropriation was made by the first session of the Seventy-fifth Congress.

Act of July 9, 1937 (Public, No. 195), providing for acquiring certain lands—part of which are within the Stanislaus National Forest—and adding them to Yosemite National Park, Calif.

Act of July 27, 1937 (Public, No. 214), providing for adding certain lands to the Rogue River National Forest, Oreg.

Act of August 12, 1937 (Public, No. 257), authorizing adding certain lands in Washington to the Columbia National Forest.

Act of August 21, 1937 (Public, No. 333), authorizing revision of boundaries, Snoqualmie National Forest, Wash., and adding certain lands thereto.

Act of June 28, 1937 (Public, No. 163), establishing the Civilian Conservation Corps for a period of 3 years and providing employment and vocational training for youthful citizens of the United States who are unemployed and in need of employment on works of public interest or utility for the protection, restoration, development, etc., of natural resources of forest and other lands and waters, and the products thereof.

Appendix

TABLE 1.—National-forest additions and eliminations, fiscal year 1937

National forest	State	Additions	Eliminations	National forest	State	Additions	Eliminations
		<i>Acres</i>	<i>Acres</i>			<i>Acres</i>	<i>Acres</i>
Angelina.....	Texas.....	¹ 388,700		Ocala.....	Florida.....	¹ 178,944	
Bitterroot.....	Montana.....	² 2,271		Ottawa.....	Michigan.....	¹ 490,069	
Do.....	do.....	³ 11,289		Ouachita.....	Arkansas.....	¹ 544,910	
Black Hills.....	So. Dakota.....	³ 398		Pisgah.....	N. Carolina.....	¹ 718,646	
Cabinet.....	Montana.....	³ 1,072		Plumas.....	California.....	³ 9,196	
Carson.....	N. Mexico.....	⁴ 1		Roosevelt.....	Colorado.....	⁴ 5	
Chattahoochee.....	Georgia.....	¹ 503,300		Sabine.....	Texas.....	¹ 439,600	
Chequamegon.....	Wisconsin.....	¹ 227,684		Sam Houston.....	do.....	¹ 491,800	
Cherokee.....	Tennessee.....	¹ 338,900		Santa Fe.....	N. Mexico.....	⁴ 228	
Chippewa.....	Minnesota.....	¹ 1,000,263		Shasta.....	California.....	³ 640	
Do.....	do.....	⁴ 4		Sitgreaves.....	Arizona.....		¹
Coconino.....	Arizona.....		¹ 360	Snoqualmie.....	Washington.....	² 200	
Conecuh.....	Alabama.....	¹ 339,573		St. Joe.....	Idaho.....	³ 240	
Croatan.....	N. Carolina.....	¹ 306,300		Sumter.....	S. Carolina.....	¹ 831,000	
Cumberland.....	Kentucky.....	¹ 1,358,214		Superior.....	Minnesota.....	¹ 1,215,616	
Davy Crockett.....	Texas.....	¹ 394,200		Tahoe.....	California.....	³ 1,938	
Deschutes.....	Oregon.....	³ 601		Do.....	do.....	⁴ 3,524	
Eldorado.....	California.....	⁴ 6,735		Talladega.....	Alabama.....	¹ 721,365	
Francis Marion.....	S. Carolina.....	¹ 414,700		Tongass.....	Alaska.....		¹ 6
Green Mountain.....	Vermont.....	¹ 478,420		Do.....	do.....	¹ 3,800	
Harney.....	S. Dakota.....	³ 558		Tonto.....	Arizona.....		¹ 48
Do.....	Wyoming.....	³ 1,641		Uinta.....	Utah.....	¹ 1,360	
Hiawatha.....	Michigan.....	¹ 11,200		Umatilla.....	Oregon.....	³ 17,388	
Homochitto.....	Mississippi.....	¹ 373,460		Wichita.....	Oklahoma.....		¹ 61,64
Kaniku.....	Idaho.....	² 28,286					
Kootenai.....	Montana.....	³ 7,767		Sub-total.....		¹ 14,104,529	62,54
Lolo.....	do.....	³ 9,747		Adjustment.....		³ 44,668	
Nantahala.....	N. Carolina.....	¹ 664,427		Total.....		¹ 14,149,197	62,54
Nicolet.....	Wisconsin.....	¹ 584,349					

¹ Made by Presidential proclamation, Executive order, or Administrative order.

² Made by donation of private lands.

³ Private lands acquired through exchange.

⁴ Private lands acquired by purchase.

⁵ Net increase through recomputations of areas, based on new survey data.

TABLE 2.—Classification of mileage in forest-road and trail system, and expenditure required to complete the system to a satisfactory standard, June 30, 1937

Class	Total	Satisfactory standard	Unsatisfactory standard	Nonexisting	Expenditure required to complete
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Dollars</i>
Forest highways.....	23,147	12,654	9,264	1,229	289,382,80
Forest-development roads.....	113,307	47,654	32,914	32,739	117,397,60
Total.....	136,454	60,308	42,178	33,968	406,780,40
Trails.....	155,815	121,229	17,267	17,319	4,859,10
Total.....					411,639,50

TABLE 3.—Construction, improvement, and maintenance of national-forest roads and trails from forest-road appropriations and other Federal and cooperative funds, by States, June 30, 1937

State	Fiscal year 1937				Total constructed to June 30, 1937		Expenditures to June 30, 1937		
	Constructed		Maintained						
	Roads	Trails	Roads	Trails	Roads	Trails	Federal funds ¹	Cooperative funds	Total funds
	Miles	Miles	Miles	Miles	Miles	Miles	Dollars	Dollars	Dollars
Ala.....	250.0	-----	223.1	-----	417.5	-----	1,840,884.80	25,278.16	1,866,162.96
Alaska.....	15.3	40.9	275.3	223.5	306.3	906.9	9,642,230.41	329,262.27	9,971,492.68
Ariz.....	119.8	83.0	4,480.4	2,791.0	3,637.0	2,371.6	16,491,400.25	1,223,012.79	17,714,413.04
Ark.....	101.3	-----	2,205.1	754.7	1,785.5	571.4	7,889,721.57	136,491.86	8,026,213.43
Calif.....	366.2	34.8	14,670.9	14,731.7	10,783.6	12,375.3	56,738,779.64	9,217,367.26	65,956,146.90
Colo.....	77.0	112.9	1,362.5	11,295.8	2,079.6	12,338.7	15,565,813.59	1,222,352.35	16,788,165.94
Fla.....	92.0	-----	1,014.0	-----	1,466.2	-----	2,771,854.50	161,728.19	2,933,582.69
Ga.....	40.3	-----	432.8	170.3	521.3	362.1	3,997,441.00	137,533.21	4,134,974.21
Idaho.....	401.1	227.7	6,728.2	25,310.5	6,658.0	21,606.8	41,199,757.90	1,954,079.98	43,153,837.88
Ill.....	42.8	-----	253.4	-----	275.6	-----	1,947,875.09	184.28	1,948,059.37
Ind.....	4.1	-----	2.3	-----	6.4	-----	114,077.95	-----	114,077.95
Kans.....	-----	-----	-----	-----	3.4	-----	2,111.51	-----	2,111.51
Ky.....	32.5	-----	114.8	-----	172.8	-----	2,165,750.51	-----	2,165,750.51
La.....	39.0	-----	122.6	-----	161.1	-----	937,438.55	-----	937,438.55
Maine.....	-----	-----	13.6	90.0	14.0	90.0	465,997.72	-----	465,997.72
Md.....	-----	-----	-----	-----	-----	-----	70.05	-----	70.05
Mich.....	271.3	-----	2,077.0	-----	2,638.2	-----	3,886,860.90	263,805.07	4,150,665.97
Minn.....	100.2	66.0	922.6	303.0	1,205.2	963.3	3,706,769.99	333,786.75	4,040,556.74
Miss.....	191.8	-----	667.3	-----	838.2	-----	3,868,047.21	2,256.58	3,870,303.79
Mo.....	173.5	-----	794.1	-----	763.0	-----	2,688,665.39	-----	2,688,665.39
Mont.....	139.2	174.0	3,831.2	22,834.0	2,561.3	19,967.3	21,349,075.47	672,314.12	22,021,389.59
Nebr.....	-----	-----	142.7	-----	116.7	-----	272,664.14	990.80	273,654.94
Nev.....	27.8	1.5	610.8	1,699.8	736.4	944.7	3,714,696.70	179,424.04	3,894,120.74
N. H.....	19.7	24.8	122.3	1,036.6	139.7	914.9	2,861,201.87	95,949.70	2,957,151.57
N. J.....	-----	-----	-----	-----	-----	-----	217.71	-----	217.71
N. Mex.....	97.8	31.4	2,581.1	3,279.0	2,449.3	1,804.5	12,149,386.62	337,089.91	12,486,476.53
N. Y.....	-----	-----	-----	-----	-----	-----	81.32	-----	81.32
N. C.....	90.6	30.1	522.4	878.7	663.4	774.5	6,392,995.42	478,528.91	6,871,524.33
N. Dak.....	-----	-----	.5	-----	1.0	-----	159.85	-----	159.85
Ohio.....	10.9	-----	-----	-----	19.4	-----	249,475.72	-----	249,475.72
Okla.....	13.3	-----	167.8	1.5	162.2	16.5	860,833.08	17,065.09	877,898.17
Oreg.....	130.7	68.4	10,655.6	15,546.0	7,160.9	9,963.1	34,689,464.80	8,573,590.65	43,263,055.45
Pa.....	15.3	-----	248.3	277.8	239.4	277.8	3,005,902.01	42,234.91	3,048,136.92
P. R.....	19.3	2.0	11.5	17.0	30.8	63.6	1,816,925.02	550.00	1,817,475.02
S. C.....	94.6	-----	351.9	18.2	357.2	18.2	1,988,725.51	15,659.81	2,004,385.32
S. Dak.....	16.9	-----	105.5	8.0	503.8	108.1	2,290,782.60	241,605.27	2,532,387.87
Tenn.....	50.9	20.0	503.5	570.4	555.5	748.0	4,403,941.34	197,596.61	4,601,537.95
Tex.....	137.9	-----	395.0	-----	395.0	-----	1,825,811.34	-----	1,825,811.34
Utah.....	73.3	100.2	2,207.1	5,690.8	2,372.5	4,186.7	10,244,242.24	1,048,158.38	11,292,400.62
Vt.....	4.8	.2	50.1	194.5	16.0	20.7	765,031.23	-----	765,031.23
Va.....	35.1	195.9	658.5	996.4	469.4	1,192.3	4,406,367.41	109,614.95	4,515,982.36
Wash.....	132.6	113.0	2,936.0	14,083.7	3,408.5	10,098.5	23,224,761.38	1,742,062.51	24,966,823.89
W. Va.....	47.9	36.8	462.2	795.2	522.0	799.0	3,692,029.64	38,159.30	3,730,188.94
Wis.....	235.0	-----	1,346.9	-----	1,510.1	-----	2,788,263.59	2,131.55	2,790,395.14
Wyo.....	35.8	40.0	1,106.7	6,246.1	1,425.1	2,763.9	9,829,336.69	407,596.51	10,236,933.20
Total.....	3,747.6	1,403.6	65,357.6	129,844.2	59,548.5	106,248.4	328,743,921.23	29,207,461.77	357,951,383.00

¹ Includes exact figures for road funds and approximate figures for C. C. C., equipment rentals, and other Government funds for the current fiscal year.

TABLE 4.—*Distribution among the States of the road and trail apportionments for the fiscal year 1938*

State	10 percent fund roads and trails for States, national-forest funds	Forest highways	Forest-road development	Total
Alabama.....	\$77. 12	\$31,250.00	\$15,185.00	\$46,512.12
Alaska.....	6,029.39	350,000.00	30,570.00	386,599.39
Arizona.....	28,022.10	547,212.00	226,324.00	801,558.10
Arkansas.....	26,691.07	111,905.00	46,225.00	184,821.07
California.....	71,540.83	1,334,121.00	763,426.00	2,169,087.83
Colorado.....	51,848.39	686,502.00	226,370.00	964,720.39
Florida.....	9,910.42	82,636.00	18,987.00	111,533.42
Georgia.....	743.83	44,605.00	28,190.00	73,538.83
Idaho.....	45,503.84	963,408.00	723,776.00	1,732,687.84
Illinois.....	132.84	14,694.00	37,671.00	52,497.84
Indiana.....	22.29	3,703.00	—	3,725.29
Kentucky.....	138.36	26,293.00	46,772.00	73,203.36
Louisiana.....	736.81	32,142.00	3,818.00	36,696.81
Maine.....	257.49	5,641.00	2,535.00	8,433.49
Michigan.....	3,100.84	117,552.00	110,690.00	231,342.84
Minnesota.....	4,059.81	112,167.00	58,274.00	174,500.81
Mississippi.....	1,434.51	68,688.00	39,216.00	109,338.51
Missouri.....	411.30	60,083.00	70,568.00	131,062.30
Montana.....	22,257.05	753,310.00	475,906.00	1,251,473.05
Nebraska.....	1,072.05	15,383.00	1,663.00	18,118.05
Nevada.....	8,288.35	171,272.00	47,352.00	226,912.35
New Hampshire.....	4,153.86	86,729.00	21,376.00	112,258.86
New Mexico.....	15,241.82	383,786.00	148,622.00	547,649.82
North Carolina.....	3,975.53	84,048.00	60,867.00	148,890.53
North Dakota.....	.50	—	—	.50
Ohio.....	25.55	3,527.00	125.00	3,677.55
Oklahoma.....	1,391.34	9,154.00	2,716.00	13,261.34
Oregon.....	63,783.08	1,254,717.00	495,984.00	1,814,484.08
Pennsylvania.....	1,623.87	40,116.00	30,361.00	72,100.87
Puerto Rico.....	56.20	3,050.00	2,657.00	5,763.20
South Carolina.....	3,122.45	45,926.00	45,045.00	94,093.45
South Dakota.....	9,806.21	125,787.00	20,667.00	156,260.21
Tennessee.....	2,633.68	49,236.00	31,603.00	83,472.68
Texas.....	2,837.86	49,674.00	35,323.00	87,834.86
Utah.....	14,658.27	313,486.00	163,717.00	491,861.27
Vermont.....	992.92	21,334.00	14,190.00	36,516.92
Virginia.....	2,645.75	89,317.00	53,415.00	145,377.75
Washington.....	51,677.90	684,890.00	321,562.00	1,058,129.90
West Virginia.....	463.81	62,644.00	54,398.00	117,505.81
Wisconsin.....	754.73	79,208.00	49,613.00	129,575.73
Wyoming.....	23,694.78	414,137.00	140,908.00	578,739.78
Total.....	485,818.80	9,333,333.00	4,666,667.00	14,485,818.80

TABLE 5.—*Distribution among the States of the total road and trail apportionments including the fiscal year 1938*

State	10 percent fund roads and trails for States, national-forest funds	Sec. 8 cooperative construction, etc., of roads and trails, national forests	Federal forest-road construction	Forest highways ¹	Forest-road development ²	Improvement ³	Total
Alabama.....	\$1,134.43	\$15,456.04	\$1,922.31	\$130,425	\$173,982	\$31,077.06	\$353,996.84
Alaska.....	193,707.27	470,963.60	203,229.50	8,985,549	394,461	—	10,247,910.37
Arizona.....	781,356.92	677,956.45	490,434.11	7,579,041	2,646,549	546,273.39	12,721,610.87
Arkansas.....	225,586.29	175,126.19	128,423.38	1,206,017	1,054,526	295,897.47	3,085,576.33
California.....	1,967,172.23	1,464,333.82	1,201,431.20	18,297,141	9,582,533	1,518,217.76	34,030,829.01
Colorado.....	979,051.16	770,948.34	784,259.55	9,090,518	2,865,277	197,297.57	14,687,351.62
Florida.....	70,240.51	119,528.14	21,534.94	475,808	269,982	140,417.47	1,097,511.06
Georgia.....	17,534.63	52,393.57	130,443.73	289,014	381,328	133,229.53	1,003,943.46
Idaho.....	1,174,382.84	1,176,750.85	1,337,004.17	13,435,245	10,904,630	1,827,886.55	29,855,899.41
Illinois.....	178.77	—	—	47,012	73,907	—	121,097.77

¹ Includes emergency funds for highways under acts of June 19, 1934, and June 16, 1933.² Includes emergency funds for development roads under acts of June 19, 1934, and June 16, 1933.³ Includes emergency improvement funds under act of July 21, 1932

TABLE 5.—*Distribution among the States of the total road and trail apportionments, including the fiscal year 1938—Continued*

State	10 percent fund roads and trails for States, national-forest funds	Sec. 8 cooperative construction, etc., of roads and trails, national forests	Federal forest-road construction	Forest highways	Forest-road development	Improvement	Total
Indiana.....	22.29			5,350			5,372.29
Kansas.....	1,867.27						1,867.27
Kentucky.....	1,014.67			71,254	199,372		271,640.67
Louisiana.....	1,100.60			98,750	87,425	38,132.47	225,408.07
Maine.....	4,812.10	32.41	3,738.77	40,586	42,650	21,909.56	113,728.84
Maryland.....	70.05						70.05
Michigan.....	10,398.75	115.63	3,000.00	436,589	681,656	164,507.86	1,296,267.24
Minnesota.....	54,006.54	8,036.36	108,352.03	1,000,874	718,029	130,348.59	2,019,646.52
Mississippi.....	2,013.52			181,576	176,151	8,598.45	368,338.97
Missouri.....	514.79			134,369	153,471		288,354.79
Montana.....	703,048.90	762,523.77	764,035.26	10,609,484	5,389,481	651,377.24	18,879,950.17
Nebraska.....	23,892.54	18.98		134,131	66,424	578.27	225,044.79
Nevada.....	218,687.64	192,989.88	81,491.85	2,474,473	278,576	45,878.18	3,292,096.55
New Hampshire.....	66,495.02	7,165.35	10,941.30	614,307	305,523	56,487.05	1,060,918.72
New Jersey.....	118.99				83		201.99
New Mexico.....	416,307.46	426,086.04	518,426.97	5,445,884	2,068,977	408,824.28	9,284,505.75
New York.....	4.00				20		24.00
North Carolina.....	54,336.54	86,336.41	176,466.28	476,973	812,542	192,530.92	1,799,185.15
North Dakota.....	46.25	7.00			125		178.25
Ohio.....	25.55			5,068			5,093.55
Oklahoma.....	16,750.09	65.49	2,775.17	86,807	196,815	35,700.19	338,912.94
Oregon.....	1,213,697.74	1,428,785.95	1,013,981.59	16,636,981	7,893,818	876,916.07	29,064,180.35
Pennsylvania.....	11,327.44	7,724.04	21.42	235,398	294,405	79,976.40	628,852.30
Puerto Rico.....	294.39	7.00	3,343.09	17,985	32,681	4,714.52	59,025.00
South Carolina.....	7,336.59	402.10	48,028.61	132,298	142,390	171.08	330,626.38
South Dakota.....	226,636.08	87,106.45	78,652.52	1,061,729	411,397	33,879.18	1,899,400.23
Tennessee.....	27,309.81	106,854.56	27,967.79	362,328	444,327	100,304.31	1,069,091.47
Texas.....	2,982.69			107,431	55,067		165,480.69
Utah.....	499,544.80	464,918.34	512,489.56	4,440,678	1,378,046	183,090.76	7,478,767.46
Vermont.....	2,624.46			53,402	79,736	10,778.15	146,540.61
Virginia.....	54,915.61	58,390.16	71,784.26	507,514	581,036	154,268.85	1,427,938.88
Washington.....	874,082.09	958,090.33	732,302.49	9,201,080	5,652,574	862,891.32	18,281,020.23
West Virginia.....	7,762.52	12,830.41	5,049.24	280,692	471,511	208,604.94	986,450.11
Wisconsin.....	1,630.43			253,654	389,765	98,415.88	743,465.31
Wyoming.....	561,389.62	468,056.34	538,468.91	5,789,918	1,915,419	102,815.87	9,376,067.74
Total.....	10,477,442.88	10,000,000.00	9,000,000.00	120,433,333	59,266,667	9,161,997.19	218,339,440.07

TABLE 6.—*Condition of forest-road funds on June 30, 1937*

Fund	Appropriations	Expenditures	Balance
10-percent.....	\$9,991,624.08	\$9,467,173.61	\$524,450.47
Section 8.....	10,000,000.00	10,000,000.00	
Federal forest-road construction.....	9,000,000.00	9,000,000.00	
Forest highways.....	76,600,000.00	76,495,665.51	104,334.49
Forest highway emergency construction.....	7,000,000.00	6,803,703.73	190,296.27
Emergency forest highways.....	8,000,000.00	7,997,245.18	(1)
Forest highways, N. R. A.....	14,600,000.00	14,556,381.39	43,618.61
Forest-road development.....	40,900,000.00	39,789,722.01	1,110,277.99
Forest-road development emergency construction.....	3,000,000.00	2,991,797.42	8,202.58
Forest-road development, N. R. A.....	10,100,000.00	10,099,627.12	2,900.72
Improvement.....	9,161,997.19	9,161,997.19	
Total.....	198,353,621.27	196,369,313.16	1,981,471.13

¹ \$2,754.82 returned to the Treasury.

² \$84.66 returned to P. W. A.; \$2.50 adjustment.

TABLE 7.—Comparison of fires on national forests, calendar years 1936, 1935, and 5-year average, 1932-36

Item	Number of fires			Percentage of totals		
	1936	1935	Average 1932-36	1936	1935	Average 1932-36
Class:						
Burns of 0.25 acre or less.....	7,026	5,946	5,354	41.75	55.63	51.
Burns of between 0.25 and 10 acres.....	6,362	3,078	3,233	37.81	28.79	31.
Burns of 10 acres and over.....	3,439	1,665	1,761	20.44	15.58	17.
Total.....	16,827	10,689	10,348	100.00	100.00	100.
Cause:						
Railroads.....	402	225	210	2.39	2.11	2.
Lightning.....	5,163	4,031	3,793	30.68	37.71	36.
Incendiarism.....	2,594	1,389	1,415	15.42	12.99	13.
Debris burning.....	2,851	775	953	16.94	7.25	9.
Lumbering.....	285	267	161	1.69	2.50	1.
Campfires.....	1,076	920	887	6.40	8.61	8.
Smokers.....	3,457	2,545	2,391	20.54	23.81	23.
Miscellaneous.....	999	537	538	5.94	5.02	5.
Total.....	16,827	10,689	10,348	100.00	100.00	100.

Calendar year	Total area of national-forest land burned over	Total damage of national-forest land burned over	Total cost of fighting fires exclusive of time of forest officers
	<i>Acres</i>	<i>Dollars</i>	<i>Dollars</i>
1936.....	280,554	1,220,187	¹ 2,689,600
1935.....	168,394	336,145	² 1,325,970
5-year average 1932-36.....	301,875	833,961	1,824,780

¹ Of this amount \$1,074,723 was Emergency Conservation Work and Emergency Relief Administration funds.

² Of this amount \$544,213 was Emergency Conservation Work and Emergency Relief Administration funds.

TABLE 8.—Quantity and value of national-forest timber cut under sales, fiscal year 1937

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alabama.....	102,000	-----	102,000	477	-----	477
Alaska.....	42,508,000	-----	42,508,000	64,056	-----	64,056
Arizona.....	60,801,000	430,000	61,231,000	139,436	449	139,885
Arkansas.....	18,444,000	311,000	18,755,000	226,527	315	226,842
California.....	174,734,000	1,691,000	176,425,000	358,574	1,344	359,918
Colorado.....	58,717,000	675,000	59,392,000	143,187	660	143,847
Florida.....	14,752,000	-----	14,752,000	82,848	-----	82,848
Georgia.....	1,719,000	-----	1,719,000	7,598	-----	7,598
Idaho.....	77,435,000	4,947,000	82,382,000	241,266	4,636	245,902
Illinois.....	38,000	-----	38,000	271	-----	271
Indiana.....	4,000	-----	4,000	57	-----	57
Kentucky.....	520,000	-----	520,000	1,357	-----	1,357
Louisiana.....	767,000	-----	767,000	966	-----	966
Maine.....	575,000	-----	575,000	1,686	-----	1,686
Michigan.....	12,240,000	2,000	12,242,000	23,839	3	23,842
Minnesota.....	12,739,000	30,000	12,769,000	27,054	20	27,074
Mississippi.....	11,721,000	-----	11,721,000	12,639	-----	12,639
Missouri.....	460,000	3,000	463,000	1,901	4	1,905
Montana.....	37,772,000	3,278,000	41,050,000	82,415	3,216	85,631
Nebraska.....	13,000	-----	13,000	25	-----	25
Nevada.....	635,000	165,000	800,000	574	131	705
New Hampshire.....	12,791,000	-----	12,791,000	41,565	-----	41,565
New Mexico.....	16,618,000	1,089,000	17,697,000	35,518	1,110	36,628
North Carolina.....	25,324,000	-----	25,324,000	46,300	-----	46,300
Ohio.....	16,000	-----	16,000	68	-----	68

TABLE 8.—Quantity and value of national-forest timber cut under sales, fiscal year 1937—Continued

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
regon	212, 439, 000	3, 823, 000	216, 262, 000	454, 784	2, 669	457, 453
ennessee	4, 341, 000	—	4, 341, 000	11, 718	—	11, 718
uerto Rico	8, 000	5, 000	13, 000	91	5	99
outh Carolina	1, 966, 000	—	1, 966, 000	10, 835	—	10, 835
outh Dakota	27, 998, 000	262, 000	28, 260, 000	78, 232	269	78, 501
ennessee	8, 281, 000	—	8, 281, 000	23, 712	—	23, 712
exas	4, 177, 000	—	4, 177, 000	27, 236	—	27, 236
ah	9, 616, 000	1, 361, 000	10, 977, 000	20, 934	1, 415	22, 349
ermont	2, 638, 000	—	2, 638, 000	9, 157	—	9, 157
irginia	11, 613, 000	—	11, 613, 000	15, 719	—	15, 719
ashington	165, 491, 000	234, 000	165, 725, 000	433, 847	193	434, 040
est Virginia	2, 254, 000	—	2, 254, 000	7, 076	—	7, 076
isconsin	3, 621, 000	8, 000	3, 629, 000	5, 601	9	5, 610
oming	41, 883, 000	875, 000	42, 758, 000	83, 274	872	84, 146
Total, 1937	1, 077, 761, 000	19, 189, 000	1, 096, 950, 000	2, 722, 483	1 17, 320	2, 739, 803
Total, 1936	794, 853, 000	19, 932, 000	814, 785, 000	2, 100, 496	1 18, 651	2, 119, 147

¹ In addition, minor products not convertible into board feet were cut, the value of which was \$39,309 in 1937 and \$30,226 in 1936.

TABLE 9.—Quantity and value of national-forest timber sold, fiscal year 1937

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alabama	224, 000	—	224, 000	1, 147	—	1, 147
Alaska	28, 148, 000	—	28, 148, 000	43, 100	—	43, 100
Arizona	59, 681, 000	527, 000	60, 208, 000	143, 750	539	144, 289
Arkansas	48, 099, 000	347, 000	48, 446, 000	797, 560	347	797, 907
California	179, 409, 000	1, 767, 000	181, 176, 000	274, 089	1, 406	275, 495
Colorado	83, 349, 000	572, 000	83, 921, 000	209, 062	576	209, 638
Florida	7, 962, 000	—	7, 962, 000	36, 622	—	36, 622
Georgia	1, 732, 000	—	1, 732, 000	7, 594	—	7, 594
Iaho	41, 400, 000	5, 210, 000	46, 610, 000	107, 401	5, 063	112, 464
Illinois	48, 000	—	48, 000	396	—	396
Indiana	4, 000	—	4, 000	57	—	57
Kentucky	518, 000	—	518, 000	1, 270	—	1, 270
Louisiana	7, 236, 000	—	7, 236, 000	57, 744	—	57, 744
Maine	344, 000	—	344, 000	1, 165	—	1, 165
Michigan	15, 518, 000	31, 000	15, 549, 000	31, 065	27	31, 092
Minnesota	24, 714, 000	48, 000	24, 762, 000	74, 330	36	74, 366
Mississippi	15, 562, 000	—	15, 562, 000	17, 381	—	17, 381
Missouri	525, 000	3, 000	528, 000	2, 120	4	2, 124
Montana	44, 383, 000	4, 927, 000	47, 310, 000	83, 916	2, 575	86, 491
Nebraska	13, 000	—	13, 000	25	—	25
Nevada	539, 000	191, 000	730, 000	527	128	655
New Hampshire	16, 569, 000	—	16, 569, 000	50, 940	—	50, 940
New Mexico	24, 394, 000	1, 253, 000	25, 647, 000	54, 672	1, 263	55, 935
North Carolina	25, 822, 000	—	25, 822, 000	47, 317	—	47, 397
Ohio	178, 000	—	178, 000	193	—	193
Oregon	192, 838, 000	3, 713, 000	196, 601, 000	559, 975	2, 693	562, 668
Pennsylvania	3, 682, 000	—	3, 682, 000	5, 891	—	5, 891
uerto Rico	8, 000	5, 000	13, 000	94	5	99
outh Carolina	7, 888, 000	—	7, 888, 000	53, 693	—	53, 693
outh Dakota	39, 067, 000	202, 000	39, 269, 000	117, 159	207	117, 366
Tennessee	12, 017, 000	—	12, 017, 000	30, 858	—	30, 858
Texas	3, 044, 000	—	3, 044, 000	14, 965	—	14, 965
Utah	10, 491, 000	1, 278, 000	11, 769, 000	23, 517	1, 310	24, 827
Vermont	1, 463, 000	—	1, 463, 000	5, 628	—	5, 628
Virginia	19, 605, 000	—	19, 605, 000	19, 489	—	19, 489
Washington	525, 229, 000	236, 000	525, 465, 000	577, 406	189	577, 595
West Virginia	2, 598, 000	—	2, 598, 000	8, 358	—	8, 358
Wisconsin	8, 185, 000	8, 000	8, 193, 000	10, 940	9	10, 949
Wyoming	19, 273, 000	1, 085, 000	20, 358, 000	39, 162	1, 071	40, 233
Total, 1937	1, 471, 809, 000	19, 403, 000	1, 491, 212, 000	3, 510, 658	1 17, 448	3, 528, 106
Total, 1936	967, 828, 000	20, 476, 000	988, 304, 000	2, 364, 998	1 18, 475	2, 383, 473

¹ In addition, minor products not convertible into board feet were sold, valued at \$25,879 in 1937, and \$3,902 in 1936.

TABLE 10.—*Planting and sowing on national forests, by States, calendar year 1937*

State	Planted	Sown	Total	State	Planted	Sown	Total
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>		<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Arkansas.....	4,814	—	4,814	Ohio.....	104	222	326
California.....	1,202	2,001	3,203	Oregon.....	971	—	971
Colorado.....	2,519	—	2,519	Pennsylvania.....	1,143	80	1,223
Idaho.....	5,384	—	5,384	South Carolina.....	501	—	501
Illinois.....	1,168	591	1,759	South Dakota.....	845	—	845
Indiana.....	335	504	839	Tennessee.....	101	—	101
Louisiana.....	23,278	—	23,278	Texas.....	3,623	—	3,623
Michigan.....	78,197	—	78,197	Washington.....	3,066	—	3,066
Minnesota.....	11,647	63	11,710	West Virginia.....	1,431	—	1,431
Mississippi.....	22,597	—	22,597	Wisconsin.....	40,372	—	40,372
Missouri.....	3,080	5,195	8,275	Wyoming.....	219	—	219
Montana.....	1,442	—	1,442	Puerto Rico.....	3,825	65	3,890
Nebraska.....	1,770	—	1,770				
New Hampshire.....	—	48	576	Total.....	214,306	8,769	223,075
North Carolina.....	144	—	144				

TABLE 11.—*Forest Service nurseries, and annual output as approved for calendar year 1936*

No.	Nursery	Location	Approved annual output ¹
1.....	Susanville.....	Susanville, Calif.....	1,000 trees
2.....	Wind River.....	Carson, Wash.....	1,000
3.....	Savenac.....	Haugen, Mont.....	3,500
4.....	McCall.....	McCall, Idaho.....	10,000
5.....	Tony Grove.....	Logan, Utah.....	1,000
6.....	Pole Mountain.....	Laramie, Wyo.....	2,000
7.....	Bessey.....	Halsey, Nebr.....	280
8.....	Monument.....	Monument, Colo.....	6,000
9.....	Cocoonino.....	Flagstaff, Ariz.....	5,500
10.....	Superior.....	Superior, Ariz.....	500
11.....	Glenwood.....	Glenwood, N. Mex.....	200
12.....	Cloudercroft.....	Cloudercroft, N. Mex.....	200
13.....	Towner.....	Towner, N. Dak.....	3,500
14.....	Lydick.....	Cass Lake, Minn.....	9,500
15.....	Cass Lake.....	do.....	11,500
16.....	Eveleth.....	Eveleth, Minn.....	5,000
17.....	Knife River.....	Two Harbors, Minn.....	14,000
18.....	Hayward.....	Hayward, Wis.....	14,000
19.....	Butternut.....	Park Falls, Wis.....	12,500
20.....	Hugo Sauer.....	Rhineland, Wis.....	14,000
21.....	Watersmeet.....	Watersmeet, Mich.....	16,000
22.....	Wyman.....	Manistique, Mich.....	22,000
23.....	Chittenden.....	Wellston, Mich.....	10,000
24.....	Beal.....	East Tawas, Mich.....	8,500
25.....	Chillicothe.....	Chillicothe, Ohio.....	9,000
26.....	Vallonia.....	Vallonia, Ind.....	6,000
27.....	Junction.....	Junction City, Ill. ²	10,250
28.....	Keosauqua.....	Ottumwa, Iowa.....	3,000
29.....	Licking.....	Licking, Mo.....	26,000
30.....	Ozark.....	Russellville, Ark.....	26,000
31.....	R. Y. Stuart.....	Alexandria, La.....	5,000
32.....	W. W. Ashe.....	Brooklyn, Miss.....	255,571
33.....	Parsons.....	Parsons, W. Va.....	
	Total.....		

¹ Based on need for planting in the area served by each nursery, and on available funds. Many nurseries are operating temporarily above or below approved annual output. Program is being adjusted to ward figures shown.

² Abandoned in spring of 1937.

TABLE 12.—*Grazing permits issued and numbers of stock allowed under pay permits on the national forests, by States, calendar year 1936*

State	Cattle, horses, and swine				Sheep and goats		
	Permits issued	Stock grazed			Permits issued	Stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Arizona.....	1, 046	177, 267	1, 009	50	91	270, 029	600
Arkansas.....	38	756	14				
California.....	1, 609	135, 042	3, 730	80	246	312, 110	399
Colorado.....	2, 908	258, 495	1, 953		839	896, 509	100
Florida.....	10	465					
Georgia.....	38	194		6	1	6	
Idaho.....	2, 869	122, 863	4, 531		1, 150	1, 223, 084	20
Maine.....	2	8					
Montana.....	1, 845	108, 747	5, 568		375	500, 469	
Nebraska.....	34	12, 372	326				
Nevada.....	308	52, 948	1, 629		122	276, 558	
New Hampshire.....	14	72	4				
New Mexico.....	2, 045	86, 584	1, 894		260	186, 746	6, 988
North Carolina.....	49	423		23	4	10	
Oregon.....	1, 072	80, 353	1, 083		392	547, 496	6
Pennsylvania.....	3	38					
South Dakota.....	650	25, 059	839		44	22, 756	
Tennessee.....	23	350					
Utah.....	4, 099	101, 628	2, 701		1, 734	680, 239	
Virginia.....	35	421	2		6	338	
Washington.....	418	14, 566	332		88	125, 688	
West Virginia.....	92	1, 282	15		158	4, 463	
Wyoming.....	852	102, 607	2, 638		314	590, 436	
Total, 1936.....	20, 059	1, 282, 540	28, 268	159	5, 824	5, 636, 937	8, 113
Total, 1935.....	20, 465	1, 315, 233	29, 085	292	6, 009	5, 681, 938	9, 148

TABLE 13.—*Trends in range use of western national forests, 1926-36*

Year	Animal-months		Total reduced to cow-months	Year	Animal-months		Total reduced to cow-months
	Cattle and horses	Sheep and goats			Cattle and horses	Sheep and goats	
1926.....	9, 521, 253	20, 666, 133	13, 654, 480	1934.....	8, 558, 651	20, 141, 495	12, 586, 950
1927.....	9, 039, 596	20, 209, 935	13, 081, 583	1935.....	7, 515, 146	17, 628, 938	11, 040, 934
1928.....	8, 407, 668	21, 230, 434	12, 643, 755	1936.....	7, 779, 145	17, 155, 774	11, 210, 300
1929.....	7, 979, 431	20, 744, 076	12, 128, 246				
1930.....	8, 417, 461	21, 259, 351	12, 669, 331	Changes from—	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
1931.....	8, 458, 526	21, 139, 250	12, 686, 376	1926 to 1934..	—10	—3	—8
1932.....	8, 382, 705	19, 457, 501	12, 274, 205	1926 to 1935..	—21	—15	—19
1933.....	8, 436, 968	18, 987, 131	12, 234, 394	1926 to 1936..	—18	—17	—18

TABLE 14.—*Livestock losses, 1936*

CATTLE AND HORSES

Region no.	From poisonous plants		From predatory animals		From disease		From other causes		Total	
	Number	Value	Number	Value	Number	Value	Number	Value	Number	Value
1.....	221	\$7,735	26	\$910	63	\$2,205	546	\$19,110	856	\$29,960
2.....	2,621	91,735	145	5,075	916	32,060	1,791	62,685	5,473	191,555
3.....	908	31,780	1,028	35,980	554	19,390	1,555	54,425	4,045	141,575
4.....	1,551	54,285	111	3,885	169	5,915	1,387	48,545	3,218	112,630
5.....	367	12,845	82	2,870	117	4,095	599	20,965	1,165	40,775
6.....	137	4,795	10	350	121	4,235	748	26,180	1,016	35,560
Total, 1936.....	5,805	203,175	1,402	49,070	1,940	67,900	6,626	231,910	15,773	552,055
Total, 1935.....	7,320	219,600	1,577	47,310	2,417	72,510	7,327	219,810	18,641	559,230

SHEEP AND GOATS

1.....	4,722	23,610	9,744	48,720	783	3,915	9,554	47,770	24,803	124,015
2.....	8,538	42,690	16,095	80,475	3,619	18,095	11,250	56,250	39,502	197,510
3.....	1,005	5,025	1,954	9,770	556	2,780	660	3,300	4,175	20,875
4.....	10,505	52,525	37,745	188,725	4,420	22,100	17,955	89,775	70,625	353,125
5.....	1,096	5,480	4,395	21,975	1,001	5,005	2,568	12,840	9,060	45,300
6.....	3,319	16,595	8,471	42,355	1,903	9,915	7,039	35,195	20,732	103,660
Total, 1936.....	29,185	145,925	78,404	392,020	12,282	61,410	49,026	245,130	168,897	844,485
Total, 1935.....	28,819	144,095	64,008	320,040	13,332	66,660	45,251	226,255	151,410	757,050

TABLE 15.—*Estimate of big-game animals on national forests, as of Dec. 31, 1936*

SUMMARY BY REGIONS

Region or State	Antelope	Bear		Deer	Elk	Moose	Mountain goat	Mountain sheep
		Black or brown	Grizzly					
Region no.:	Number	Number	Number	Number	Number	Number	Number	Number
1.....	1,132	8,237	518	111,037	32,647	2,027	5,607	1,186
2.....	980	4,980	109	112,624	28,222	481	18	4,052
3.....	6,080	2,170	5	167,550	5,460	-----	-----	290
4.....	4,800	4,210	70	166,615	32,090	2,435	1,475	3,865
5.....	3,020	12,838	-----	273,500	175	-----	-----	345
6.....	920	12,440	7	162,905	27,302	-----	5,490	60
7.....	-----	2,285	-----	46,039	44	2	-----	-----
8.....	-----	790	-----	34,049	35	-----	-----	-----
9.....	-----	3,240	-----	324,598	20	1,036	-----	-----
10.....	-----	6,700	14,500	42,850	60	535	5,800	1,575
All regions.....	16,932	57,891	5,209	1,441,767	126,055	6,516	18,390	11,373

SUMMARY BY STATES

Alabama.....	-----	6,700	14,500	930	-----	-----	-----	-----
Alaska.....	-----	820	-----	42,850	60	535	5,800	1,575
Arizona.....	5,040	6	-----	81,090	4,605	-----	-----	175
Arkansas.....	-----	6	-----	6,277	17	-----	-----	-----
California.....	3,020	12,838	-----	273,500	175	-----	-----	345
Colorado.....	212	3,936	7	82,300	16,879	-----	-----	2,510
Florida.....	-----	110	-----	8,675	-----	-----	-----	-----
Georgia.....	-----	5	-----	448	-----	-----	-----	-----
Idaho.....	4,425	5,563	67	88,427	19,370	705	3,347	1,920
Illinois.....	-----	-----	-----	13	-----	-----	-----	-----
Louisiana.....	-----	-----	-----	283	-----	-----	-----	-----
Maine.....	-----	30	-----	286	-----	-----	-----	-----
Michigan.....	-----	640	-----	134,937	20	-----	-----	-----
Minnesota.....	-----	1,750	-----	98,839	-----	1,036	-----	-----
Mississippi.....	-----	-----	-----	179	-----	-----	-----	-----
Missouri.....	-----	-----	-----	358	-----	-----	-----	-----

1 Includes Alaska brown bear.

TABLE 15.—*Estimate of big-game animals on national forests, as of Dec. 31, 1936—Continued*

Region or State	Antelope	Bear		Deer	Elk	Moose	Mountain goat	Mountain sheep
		Black or brown	Grizzly					
	Number	Number	Number	Number	Number	Number	Number	Number
Montana.....	1,132	5,159	466	79,330	19,271	1,657	3,715	966
Nebraska.....				264				
Nevada.....	200			12,200	140			200
New Hampshire.....		300		1,400				
New Mexico.....	1,040	1,350	5	86,460	855			115
North Carolina.....		631		11,945	18			
Ohio.....		5						
Oklahoma.....		5		1,400				
Oregon.....	920	5,490		116,840	15,552			50
Pennsylvania.....		250		38,958				
South Carolina.....		4		1,022				
South Dakota.....	14			5,450	417		18	
Tennessee.....		29		555				
Texas.....				2,325				
Utah.....	175	460		89,300	2,950			125
Vermont.....		100		1,000		2		
Virginia.....		755		2,230	44			
Washington.....		7,280	7	48,870	11,756		5,510	10
West Virginia.....		851		2,165				
Wisconsin.....		850		90,451				
Wyoming.....	754	1,979	157	30,200	33,926	2,581		3,382
All States.....	16,932	57,891	1 5,209	1,441,767	126,055	6,516	18,390	11,373
Total, 1935.....	16,598	55,079	1 5,269	1,291,329	117,916	6,186	18,511	12,924

TABLE 16.—*Appropriations for State cooperation, fiscal years 1936-38*

Item	Amount appropriated for the fiscal year —		
	1936	1937	1938
For prevention and suppression of forest fires, and for forest-taxation inquiry and insurance study (secs. 1-3, Clarke-McNary law).....	\$1,578,632	\$1,655,007	\$1,655,007
For distribution of forest planting stock to farmers (sec. 4, Clarke-McNary law).....	56,379	70,579	70,579
For farm-forestry extension (sec. 5, Clarke-McNary law, administered by Division of Cooperative Extension).....	56,838	56,838	56,838

TABLE 17.—*Cooperative expenditures for fire protection and distribution of forest-planting stock under the Clarke-McNary Act, fiscal year 1937*

State	For fire protection				For the distribution of forest-planting stock ¹		
	Federal	State	Private agencies	Total	Federal	State	Total
Alabama.....	\$36,530.00	\$22,951.82	\$28,851.04	\$88,332.86	\$513.71	\$2,749.26	\$3,262.97
Arkansas.....	41,560.00	16,048.42	45,709.64	103,318.06	1,852.00	8,634.61	10,486.61
California.....	152,393.00	588,625.16	12,693.53	753,711.69			
Colorado.....					1,708.00	5,094.30	6,802.30
Connecticut.....	16,053.00	57,764.07	2,847.05	76,664.12	194.00	198.38	392.38
Delaware.....	1,630.00	7,066.08		8,696.08	1,467.95	1,467.94	2,935.89
Florida.....	70,780.00	110,131.10	61,127.81	242,038.91	1,834.00	6,758.67	8,592.67
Georgia.....	69,843.00	19,552.92	66,990.19	156,386.11	1,779.00	6,214.65	7,993.65
Hawaii.....	994.00	2,585.49		3,579.49	900.00	932.23	1,832.23
Idaho.....	53,349.00	65,247.11	91,567.00	210,163.11	1,600.00	2,468.21	4,068.21
Indiana.....	6,720.00	23,752.08		30,472.08	1,886.00	9,449.90	11,335.90
Iowa.....					1,600.00	19,199.47	20,799.47
Kansas.....					1,734.00	7,234.97	8,968.97

¹ A total of 35,647,809 trees were distributed during the calendar year 1936. The State of New York led with a distribution of 3,845,500 trees under this cooperative program.

TABLE 17.—*Cooperative expenditures for fire protection and distribution of forest planting stock under the Clarke-McNary Act, fiscal year 1937—Continued*

State	For fire protection				For the distribution of forest-planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Kentucky.....	12,460.00	12,721.08	-----	25,181.08	1,654.00	2,480.10	4,134.10
Louisiana.....	42,408.00	63,415.88	32,098.82	137,922.70	1,600.00	8,511.44	10,111.44
Maine.....	49,796.00	128,817.84	-----	178,613.84	513.94	513.91	1,027.85
Maryland.....	12,123.00	36,717.37	233.02	49,123.39	1,600.00	3,649.90	5,249.90
Massachusetts.....	23,822.00	112,396.37	-----	136,218.37	1,744.00	6,852.93	8,596.93
Michigan.....	108,515.00	458,709.56	-----	567,224.56	1,889.00	7,079.89	8,968.89
Minnesota.....	85,393.00	665,966.10	-----	751,359.10	-----	-----	-----
Mississippi.....	45,040.00	18,188.13	52,346.32	115,574.45	1,383.64	1,549.23	2,932.87
Montana.....	23,742.00	18,857.43	55,159.73	97,759.16	1,709.00	6,098.41	7,807.41
Nebraska.....	-----	-----	-----	-----	2,224.00	17,608.28	19,832.28
Nevada.....	1,755.00	211.00	4,629.60	6,595.60	-----	-----	-----
New Hampshire.....	15,297.00	28,990.48	5,704.81	49,992.29	1,740.00	3,055.58	4,795.58
New Jersey.....	23,208.00	140,646.88	-----	163,854.88	1,953.00	9,701.66	11,654.66
New Mexico.....	2,080.00	1,918.28	416.13	4,414.41	-----	-----	-----
New York.....	63,133.00	261,876.71	-----	325,009.71	1,903.00	6,122.82	8,025.82
North Carolina.....	51,560.00	94,554.50	14,784.53	160,899.03	1,721.00	5,637.43	7,358.43
North Dakota.....	-----	-----	-----	-----	1,829.00	7,249.21	9,078.21
Ohio.....	5,600.00	14,092.78	-----	19,692.78	1,913.00	12,439.93	14,352.93
Oklahoma.....	13,253.40	7,253.43	6,000.00	26,506.83	1,693.00	5,184.96	6,877.96
Oregon.....	81,311.00	54,137.15	298,060.65	433,508.80	1,600.00	2,063.71	3,663.71
Pennsylvania.....	47,368.00	204,094.16	-----	251,462.16	1,876.00	11,044.57	12,920.57
Puerto Rico.....	-----	-----	-----	-----	2,022.00	11,887.09	13,909.09
Rhode Island.....	2,290.00	13,715.92	-----	16,005.92	-----	-----	-----
South Carolina.....	32,820.00	61,357.20	20,954.67	115,131.87	1,685.00	6,028.06	7,713.06
South Dakota.....	850.00	2,018.90	-----	2,868.90	1,815.00	8,585.70	10,400.70
Tennessee.....	19,600.00	75,987.70	630.52	96,218.22	1,736.00	6,934.29	8,670.29
Texas.....	39,701.00	105,518.14	9,215.00	154,434.14	1,600.00	2,581.66	4,181.66
Utah.....	-----	-----	-----	-----	1,666.00	3,663.53	5,319.53
Vermont.....	5,500.00	9,048.45	3,153.04	17,701.49	1,535.00	3,475.64	5,010.64
Virginia.....	31,760.00	45,625.39	1,642.00	79,027.39	1,600.00	1,974.42	3,574.42
Washington.....	86,746.00	107,050.51	387,995.07	581,791.58	1,843.20	3,970.45	5,813.65
West Virginia.....	32,504.00	69,053.10	24,814.00	126,371.10	1,704.00	3,119.90	4,823.90
Wisconsin.....	62,858.00	424,977.76	-----	487,835.76	1,687.00	8,469.59	10,156.59
Wyoming.....	-----	-----	-----	-----	1,312.50	2,331.76	3,644.26
Administration and inspection.....	131,881.57	-----	-----	131,881.57	2,737.74	-----	2,737.74
Total.....	1,604,231.97	4,151,642.45	1,227,674.17	6,983,548.59	70,357.68	250,258.40	320,616.08
Forest-taxation and insurance study.....	44,642.00	-----	-----	-----	-----	-----	-----
Impoundment.....	5,800.00	-----	-----	-----	-----	-----	-----
Unexpended balance.....	333.03	-----	-----	-----	221.32	-----	-----
Total appropriation.....	1,655,007.00	-----	-----	-----	70,579.00	-----	-----

TABLE 18.—*Prairie States forestry project, Shelterbelt plantings, spring of 1937*

DATA FOR 1937

State	Shelterbelt	Plantations	Farms served	Trees planted—		
				In new plantations	In replacements, completions, and improvements	Total
	Miles	Acres	Number	Number	Number	Number
North Dakota.....	82.0	902	114	720,000	3,210,000	3,930,000
South Dakota.....	144.0	1,728	290	1,583,900	2,481,800	4,065,700
Nebraska.....	338.6	4,087	529	2,050,593	1,421,351	3,471,944
Kansas.....	201.6	2,333	367	1,210,674	2,046,545	3,257,219
Oklahoma.....	332.9	3,672	585	1,837,220	1,214,396	3,051,616
Texas.....	225.5	2,561	280	1,340,033	1,290,475	2,630,508
Total.....	1,324.6	15,283	2,165	8,742,420	11,664,567	20,406,987

SUMMARY FOR PREVIOUS YEARS (ALL STATES)

1935.....	125.0	7,514	2,152	5,615,183	-----	5,615,183
1936.....	1,152.8	24,521	2,212	17,526,068	629,810	18,155,878
Grand total.....	2,602.4	47,318	6,529	31,883,671	12,294,377	44,178,048

TABLE 19.—Average yearly number and distribution of Civilian Conservation Corps camps maintained for forestry work during the 4 years ended, respectively, Mar. 31, 1934, 1935, 1936, and 1937

Class of work	1934	1935	1936	1937
	Number	Number	Number	Number
National forest.....	525	471	644	481
State forest.....	319	305	366	286
Private forest.....	221	171	230	171
Tennessee Valley Authority.....	20	21	34	26
Total.....	1,085	968	1,274	964

Expenditures by classes, fiscal year 1937

Expenditures during the fiscal year were as follows:

General administration.....		\$1,206,041.31
Administration, protection, improvement, reforestation, and extension of national forests:		
Operating expenditures:		
Timber use.....	\$1,471,452.18	
Grazing use.....	1,113,808.50	
Recreation and land use.....	855,752.34	
Fish and game protection.....	642,728.90	
Classification, settlement, and claims.....	128,409.62	
Maintenance of truck and horse trails.....	3,386,771.05	
Maintenance of other improvements.....	1,671,220.42	
Subtotal.....		\$9,270,143.01
Protection expenditures:		
Fire prevention and detection.....	\$5,266,025.70	
Fire suppression.....	1,693,703.09	
Class total (fire).....	6,959,728.79	
Protection against insects and tree diseases.....	131,528.63	
Subtotal.....		7,091,257.42
Investment expenditures:		
Construction of truck and horse trails.....	\$12,633,627.96	
Construction of other structural improvements.....	11,318,856.09	
Equipment and stores.....	5,348,658.90	
Timber surveys and plans.....	566,033.39	
Grazing surveys and plans.....	134,137.80	
Fish and game surveys and plans.....	267,955.76	
Recreational-use surveys and plans.....	233,934.37	
General surveys and plans.....	561,049.70	
Timber-stand improvement.....	892,107.51	
Reforestation of denuded areas.....	1,137,319.25	
Nurseries and planting stock.....	396,381.84	
Acquisition of land by direct purchase.....	15,253,945.47	
Acquisition of land by exchange.....	198,692.71	
Nonstructural improvements (erosion, tree-disease and insect control, fire-hazard reduction, and miscellaneous investments not otherwise classified).....	5,067,901.48	
Subtotal.....		53,910,602.23
Construction and maintenance of forest highways:		
Construction of forest highways.....	\$7,601,526.54	
Maintenance of forest highways.....	913,015.82	
Subtotal.....		8,514,543.36
Total, national forests.....		78,786,546.02
Prairie States Forestry Project (including nurseries):		
Current expenditures:		
General administration.....	\$71,265.35	
Maintenance of improvements.....	330,925.00	
Subtotal.....		\$402,190.35
Investment expenditures:		
Construction of other improvements.....	\$142,937.74	
Equipment and stores.....	160,473.66	
Reforestation of denuded areas.....	664,166.57	
Nurseries and planting stock.....	358,319.40	
Nonstructural improvements (erosion, tree-disease and insect control, fire-hazard reduction, and miscellaneous investments not otherwise classified).....	2,563.06	
Subtotal.....		1,328,460.43
Total, Prairie States Forestry Project.....		1,730,650.78

¹ In addition to the expenditure for acquisition of land by exchange, national-forest timber having an estimated value of \$448,869 was cut under agreements involving the acquisition of land and timber through exchange. Cash expenditures recorded opposite Acquisition of land by exchange cover merely the outlay incidental to examining lands offered for exchange and appraising the value involved.

Expenditures by classes, fiscal year 1937—Continued

Research:

Research current expenditures:

Forest management.....	\$1, 850, 455. 50
Range investigations.....	319, 353. 28
Forest products.....	101, 432. 18
Forest survey.....	573, 769. 70
Forest economics.....	115, 402. 82
Forest influences.....	302, 833. 25
Forest taxation and insurance.....	38, 635. 00
Maintenance of roads and trails.....	14, 870. 21
Maintenance of other improvements.....	81, 684. 12
Fire prevention and detection on experimental areas.....	3, 312. 14

Subtotal..... \$3, 401, 748. 20

Research investments:

Construction of roads and trails.....	\$13, 722. 60
Construction of other improvements.....	473, 648. 43
Equipment and stores.....	248, 654. 19
Timber surveys and plans, experimental areas.....	8, 467. 73
General surveys and plans, experimental areas.....	57, 941. 15
Timber-stand improvement, experimental areas.....	4, 871. 70
Nonstructural improvements on experimental areas (erosion, tree-disease and insect control, fire-hazard reduction, and miscellaneous investments not other- wise classified).....	84, 677. 79

Subtotal..... 891, 983. 39

Total..... \$4, 293, 731.

Protection and reforestation of other than national-forest lands:

Tree planting in cooperation with States and others.....	\$94, 418. 42
Fire protection in cooperation with States and others.....	1, 848, 742. 48
Protection of Oregon and California grant lands.....	82, 982. 56
Extension of forestry practice on State and private lands.....	302, 151. 37

Total..... 2, 328, 294.

Emergency Conservation Work on other than national-forest lands:

State and private camp expenditures.....	\$16, 371, 943. 30
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Total..... 16, 371, 943.

Miscellaneous:

Emergency unemployment relief; cooperation with other agencies in con- nection with Emergency Conservation Work for which these agencies are responsible.....	\$382, 273. 49
Emergency unemployment relief; Federal Emergency Relief Adminis- tration, etc.....	178, 505. 67
Tennessee Valley Authority; Emergency Conservation Work.....	601, 392. 77
Insular Forests, Puerto Rico; Emergency Conservation Work.....	398, 561. 95
Navy Department; Emergency Conservation Work.....	96, 761. 39
War Department; Mississippi floodway land appraisal.....	79, 195. 41
Examination and administration of power sites for Federal Power Com- mission.....	10, 436. 28
Miscellaneous cooperation with other departments, bureaus, and indi- viduals.....	1, 603, 968. 07

Total..... 3, 351, 095.

Grand total..... 108, 068, 302.

Expenditures by sources, fiscal year 1937

Preceding expenditures were authorized by diverse acts of Congress, some directly appropriating funds for the Forest Service, some placing funds initial at the disposal of other agencies. Each appropriation item and each allocation of funds is necessarily handled as a separate account, to assure that all disbursements are made in accordance with the law governing the use of the particular fund drawn upon. Space limitations of this report prevent a full showing of the legislative source of each fund and of the legislative authority to make the expenditures shown, for the purposes shown. All that can be done here is to list the expenditures of the year, from the standpoint of source, under the abbreviated captions used within the Forest Service to distinguish the individual accounts. To those familiar with the work of the Service, these captions will, in varying degree, be self-explanatory.

Expenditures by sources, fiscal year 1937—Continued

Salaries and expenses, Office of Solicitor.....	\$28,299.40
Salaries and expenses, District of Columbia.....	565,232.00
Salaries and expenses, regional (protection and administration).....	10,704,728.89
Fire fighting.....	1,916,520.86
Forest products.....	606,258.66
Range investigations.....	181,082.22
Forest management.....	618,625.47
Forest survey.....	199,551.21
Forest economics.....	90,666.60
Forest influences.....	98,664.87
Water rights.....	8,991.96
Cooperative distribution of planting stock.....	70,307.58
Forest-fire cooperation.....	1,647,345.26
Forest-road development.....	2,643,444.01
Forest highways.....	142,922.90
Cooperative work, Forest Service.....	718,309.98
Roads and trails for States (10 percent).....	398,060.98
Acquisition of lands (no year).....	15,814.88
Acquisition of lands, 1937.....	1,005,682.18
Cooperative repayments.....	90,461.76
Undeposited cooperation.....	1,583,241.88
Conservation and use of agricultural land resources, 1936-37.....	470,796.86
Special research fund, Department of Agriculture.....	2,540.32
Working fund, flood control, Mississippi River.....	78,010.45
Working fund, Federal Power Commission.....	1,005.77
Salaries and expenses, Soil Conservation Service.....	52,099.80
Working fund, Department of Justice.....	29,473.52
Acquisition of lands, Uinta and Wasatch National Forests.....	47,620.18
I. R. A.:.....	
Highways.....	1,270.35
Development.....	11,024.42
Forest Service.....	7,419.88
Forest Service.....	2,955.59
Emergency highways, act of June 19, 1934.....	26,267.39
Emergency development roads, act of June 19, 1934.....	93,412.10
Emergency Conservation funds:.....	
Acquisition, 1935—Mar. 31, 1937.....	11,932.39
Acquisition, 1935—Mar. 31, 1937 (Jefferson National Forest).....	60,000.00
Other, 1937, Mar. 31, 1937.....	19,751,775.98
Other, act of Feb. 9, 1937.....	6,679,495.46
State, 1937, Mar. 31, 1937.....	12,635,243.58
State, act of Feb. 9, 1937.....	4,014,927.32
Emergency relief:.....	
Administrative expenses 1935-37.....	690,196.22
Administrative expenses 1936-38.....	472,544.81
Transient 1935-37.....	114,660.95
Forestation 1935-37.....	7,920,884.21
Forestation 1936-37.....	16,369,810.27
Rural rehabilitation, Resettlement Administration, 1935-37.....	303,348.63
Rural rehabilitation, Resettlement Administration, 1936-37.....	234,428.19
Works Progress Administration.....	20,218.39
Expenditures 1937 from appropriations of previous years (obligated in previous years but not included in previous expenditure reports):.....	
Emergency Conservation Fund:.....	
Acquisition.....	7,222,395.92
Expenditures by Bureau of Public Roads for forest highways:.....	
Forest highways.....	5,550,097.24
Forest road development.....	2,241.42
Roads and trails for States (10 percent).....	29,538.13
Cooperative work, Forest Service.....	336,318.72
Undeposited cooperation.....	420,062.83
N. I. R. A. highways.....	272,189.53
Emergency highways act of June 19, 1934.....	797,882.49
Total.....	108,068,302.86
Summary of expenditures by appropriations:.....	
Regular annual appropriations.....	18,345,493.61
Regular continuing appropriations.....	8,860,130.01
Cooperation (deposited, undeposited, repayments, etc.).....	3,148,395.17
Emergency appropriations (Emergency Conservation work on other than national-forest lands).....	16,650,170.90
Emergency appropriations (all other).....	53,841,717.25
1937 expenditures from 1935 emergency appropriations (obligated in 1935 but not previously reported as expenditures).....	7,222,395.92
Total.....	108,068,302.86

Gross and net cash receipts from national forests, fiscal year 1937

Gross receipts from national forests:

From the use of timber.....	\$2,924,470.
From the use of forage.....	1,580,345.
From special land uses, water power, etc.....	431,367.
Total.....	4,936,183.

Less payments to States:

To Arizona and New Mexico, account school lands administered by Forest Service.....	27,995.
To States in which national forests are located under act of May 23, 1908.....	¹ 1,214,547.

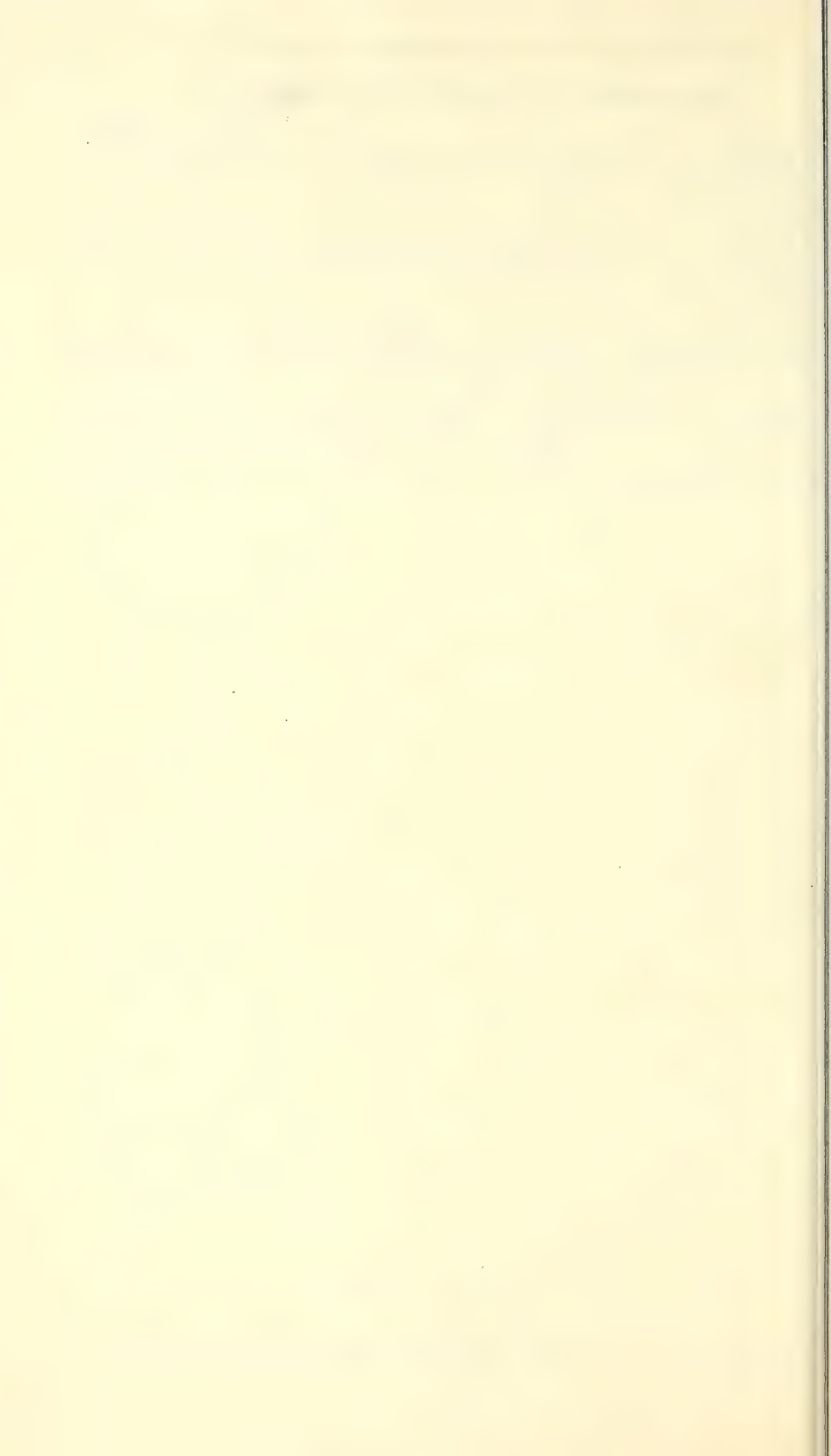
Total to States.....	1,242,542.
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Net total receipts to United States Treasury.....	3,693,641.
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¹ Computed on basis of total receipts less (1) payments to Arizona and New Mexico on account of school lands administered by Forest Service, and (2) portion of receipts from Uinta and Wasatch National Forests during the fiscal year appropriated in the appropriation act for Department of Agriculture, fiscal year 1937 for acquisition of lands, and authorized by act of Aug. 26, 1935 (49 Stat. 866), \$50,000.

The total of the gross is greater by \$873,219.88 than that for the previous year. Receipts from timber increased \$721,233.81. Grazing receipts increased \$138,851.84 and miscellaneous receipts increased \$13,134.23.

In addition to cash receipts from timber, there should be credited the value of the timber cut under specific agreements for effecting land exchanges, estimated at \$448,869.



REPORT OF THE CHIEF
OF THE FOREST SERVICE

1938



U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1938

Report of the Chief of the Forest Service 1938

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,

HON. HENRY A. WALLACE,
Secretary of Agriculture.

Washington, D. C., September 15, 1938.

DEAR MR. SECRETARY:

In transmitting my annual report, attached, I feel impelled to call attention to the following:

1. We need in forests all the 630 million acres we now have and that are more valuable for forest growth.

2. Yet unless it is abused and neglected, we probably do not and will not need more forest land.

3. For 300 years our forests have been chopped, burned, and depleted. Yet with care and forethought there seems no excuse for a timber famine of national proportions. This may not be true of many regions and localities.

4. We probably need no more forest land, yet in many regions and localities to increase national income and to help underwrite a permanent and a more prosperous civilization, we do need more and better forests.

5. Public ownership and management are established public policies, yet private ownership holds the key to our forest situation.

6. Many private owners have made progress in forest-fire protection, and some owners are leaving lands in better growing condition. Yet these things do not of themselves assure security and stability to dependent families and communities or to forest industries.

7. Some private owners have also made real progress toward establishing sustained yield, and credit is due them, but the big majority is still geared to quick liquidation.

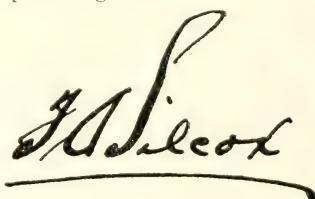
8. Human needs form the keynote of the President's message calling attention to our forest problem and the need for a policy and plan of action with respect to it.

9. In his message the Chief Executive holds that "The public has certain responsibilities and obligations with respect to private forest lands," but that "so also have private owners with respect to the broad public interests in those same lands."

10. Suggesting (a) public cooperation (Federal and State) with private owners, (b) public regulation of forest lands, (c) extension of public ownership and management of forest lands, the President recommends study by a joint committee of the Congress as a basis for action at the next session thereof.

Upon request the Forest Service is assembling data for the Congressional committee and is cooperating with private and public agencies.

Sincerely,



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We Need More Forests

WHEN Jamestown and the Plymouth colonies were established there were in what is now known as the continental United States some 820 million acres of forest land.

After a young and restless Nation had crossed the Alleghenies and the Appalachians, expanded beyond the Lakes States and into the Deep South, scaled Rockies, Cascades, and Sierras: after more than 100 years of pioneering and progress our forest lands now total 630 million acres.

This is half again as large as all our cropland; bigger than all our territory east of the Mississippi River; nearly one-third of the continental United States exclusive of Alaska. As a whole it is more valuable as forest than it is as plow land.

In generations to come a few thousand acres of this land—or a few hundreds of thousands—may be needed for storage reservoirs or some other purpose. But with minor exceptions and unless it is laid waste as a result of abuse or neglect, we can apparently expect that most of this 630 million acres will always be most valuable in forest growth.

Figuring in terms of houses, barns, railroad ties, telephone poles, furniture, boxes, fence posts, firewood—and of plastics, films, lacquers, newspapers, naval stores, dyestuffs, distillates, rayons, and thousands of things having wood as their base—we cannot use 168 million of these acres. This noncommercial forest land is an area larger than Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland, West Virginia, and Ohio. More and better forests are needed on it to help protect watersheds, reduce damage by floods and erosion, clear up muddy streams, restore depleted and impaired water resources, conserve remaining wildlife, afford opportunities for outdoor recreation. But from the standpoint of timber products, this 168 million acres probably always will be noncommercial forest land.

This leaves about 462 million acres. It, too, helps protect watersheds. But as commercial forest land it is the only area we can count on, with care and forethought, as our main source for forest products for domestic consumption and for export.

Even so, it looks as if we had enough forest land; as if as a Nation we now need no more and probably will not need more. Yet on the forest land we have, both now and in the future, we do need more and better forests. We need them because we have drawn on a living

resource without replenishing it; because for more than 3 centuries we have abused a heritage that was once one of the greatest forests all the world; because we are now paying for that abuse in terms of erosion and floods, in terms of reservoirs, rivers, and harbors choked with silt, and in terms of families, communities, and whole counties left desolate and forlorn.

We need more and better forests because this is a price we can no longer afford to pay. We need them because, of our 462 million acres of commercial forest lands,

(1) About 73 million acres—an area almost as large as all of Virginia, North Carolina, and South Carolina—is now producing so little it is virtually a no man's land.

(2) About 174 million acres—more than Kansas, Oklahoma, Missouri, and Arkansas—are, with few exceptions, not so heavily stocked as they should be and bear trees that are of less than saw timber sizes, with many diseased, otherwise defective, or weed trees among them.

(3) Only about 215 million acres now bear trees of saw-timber sizes. This area includes our remaining virgin forests. It is larger than all of Montana, Idaho, and Wyoming, but it makes up only about 46 percent of our commercial forest land and only about one-third of all our forest land.

The past has witnessed many estimates of our forest resources. One is known as the Capper Report. Another is called the Copeland Report. Each summarized the forest situation on the basis of the most authentic and most complete data then available. Each drew from these data conclusions honestly and openly arrived at, though in the opinion of some, both reports overemphasized the imminence of a timber shortage.

The Forest Service is now in the midst of a comprehensive Nation-wide forest survey. This is, briefly, a quantitative and qualitative inventory. It will tell what forests we have and where they are; how, when, and where forest depletion takes place, and how much of it there is; what our requirements for forest products are; how much forest growth we now have, where it is, and how much can be produced under adequate protection and management.

This inventory had not been started when the Capper Report was compiled in 1920. But little data had been gathered when the Copeland Report was assembled in 1933. The present survey is a huge task. When completed, the Nation-wide picture as we have known it may change somewhat. But enough progress has already been made to indicate that on an over-all basis, with reasonable care, the forest lands we now have are capable of producing all the timber we need for domestic consumption plus a comfortable margin for export.

If care and forethought are used there is, it now seems, no excuse for a timber shortage of national proportions. But this is not true of

many broad regions. There are many of them, and many localities; that for years have been face to face with progressive forest depletion, many that already face a shortage with respect to valuable species and grades they once produced in such abundance.

Many of these regions and localities still have forests of a kind; they still produce forest products. But output within them is often insufficient in volume to meet local needs, and in large part it is now confined to less-desirable and less-valuable species and grades. Under these conditions many regions and many localities now use less forest products than they really need, import little because long and costly hauls are involved, and use substitutes.

So, though there is no excuse for a timber shortage of national proportions, there is need for more and better forests.

More and better forests are needed for New England, whose tall mast of clear white pine once helped a tiny American fleet defy the Mistress of the Seas; for the Lakes States, formerly a great forest reservoir, and for the nearby Middle West, both of them now dependent on hauls so long that transportation often doubles the price of sorely needed forest products.

For the South, too, more and better forests are needed; a crescent-shaped South that, stretching from Virginia to Texas, has access by ship and rail to foreign and domestic markets; a South that, sorely needing new and more permanent industries, has 60 percent of its area in forest lands most of which are producing 50 percent or less of what they are capable of producing.

For more than 300 years our forests have been chopped, burned, and depleted. Instead of being cropped they have on the whole been exploited and ravished. Now huge sections of our country, endowed with lands still most valuable for forest purposes, must use less desirable species and grades, or substitutes, or must get many vital forest products on a basis of long and costly hauls. So, though the forest lands we have seem sufficient for present and future needs, we need in them more and better forests.

An Investment in Security

ON the forest land we have we need more and better forests to help underwrite industries dependent on them: Sawmills, planing mills, remanufacturing plants, furniture and other factories that with forests had in normal times a capital value estimated at 10 billion dollars; to help underwrite a gross production that averaged close to 2 billion dollars each year, a production that with forests themselves provided pay rolls supporting some 6 million people and making homes, churches, and schools possible for them.

We need more and better forests because, bound up with uses of land for farm purposes, they are part and parcel of a unified agriculture. We need them, too, in areas like the Ozarks and the Cumberland lands, for people in regions within which part-time and often precarious farming cannot support thousands of families and hundreds of communities once dependent on original forests, in areas in which there is now too little opportunity for other than forest work.

Like parasites on the past, we draw continuously on coal and iron and oil. We have immense reservoirs of them, but these reservoirs are nonrefillable. Through photosynthesis forests transform solar energy into wealth in the form of a tremendously wide range of physical and chemical products. Forests are the cheapest known source of cellulose, from which there is now made a truly enormous number of things that, like paper, plastics, cellophane, and rayon, are essential to modern living. And forests are refillable reservoirs. Through proper use they increase the wealth of the Nation.

Consumption of forest products often bears little relation to real need for them. This is true of wood used for construction and upkeep of residences and farm buildings, by railroads, industries, and the like. It is also true of the thousands of things, little and big, made from cellulose and lignin. Use of forest products depends on many and variable factors. Scarcity and poor quality of forests in regions of heavy population where wood products are needed, and prices based in large part on long and costly hauls rather than on short and inexpensive ones, are examples in point.

We often need forest products irrespective of such factors. It is reasonable to assume that the greater the supply of timber in regions where forest products are needed most, the greater the use of those products there will be. For they are available, then, to the rank and file—to salaried people and wage earners, who have the bulk of the buying power. The social benefits of forests—their employment of labor for planting, protecting, improving, harvesting, and processing operations—are greater when forests are relatively near large centers of population.

In themselves these things indicate the need for more and better forests.

Use in the United States is not, however, the only measure of our opportunities for utilizing wood in its existing and potential forms. There are many countries that depend on importations of forest products for a large part of their requirements. The United Kingdom is an outstanding example. Our exports, world-wide, include not only lumber but such things as veneer, plywood, and doors. Logs and timbers are also exported.

Moreover, products of the pulp and paper industry are perhaps the most significant forest products in world trade today. And it is well to remember, in this connection, that, except for the Union of Soviet

Socialist Republics, the only big reserves of soft pulpable woods now left are in the southeastern United States, including Oklahoma and Texas, and in a Northwest that includes Oregon, Washington, Alaska, and part of Canada.

In view of such things as these it is a bold man indeed who at this time would attempt to say in what form wood may be used, that the world will not use more wood than it does now, or that investments in more and better forests will not pay. Particularly since throughout the world and over a long period of years the tendency has been for the consumption of wood to increase, and since our forests are capable of supplying the kinds of wood the world demands. A large part of our forest exports are now within the range of quality woods. If we are to keep this business we must continue to grow better forests. And if we grow more, there should be a good chance of exporting more forest products and of maintaining and increasing our purchasing power.

Irrespective, however, of domestic or world-wide demands for forest products and of fluctuations in those demands, we need more forests to help protect huge watersheds and keep dams and reservoirs secure; to help save fine farms and prosperous industrial cities in lowlands from damage by floods and erosion; to provide home and refuge for big game and other wildlife; to furnish opportunities for more people to enjoy healthful recreation and the joys and delights of mountain and forest magic.

We need more and better forests as an investment in national security.

Forests and the National Income

THREE-QUARTERS of all our commercial forest land is in private ownership. Much of it has been abused, but its forests can still be made much more productive. Potentially, therefore, this forest land, which lies within striking distances of rural populations and hundreds of thousands of people who need jobs, is an immense work reservoir.

Private owners have not tackled the jobs of rebuilding and improving their forests and forest lands on anywhere near an adequate scale. Yet with millions of acres idle as well as partly productive, and with the opportunities more and better forests have to serve as employment buffers and increase the wealth of the nation, there is need—with adequate public safeguards—to find some way to accomplish forest rehabilitation on all forest land, irrespective of ownership.

Unless public ownership is considered as an alternative, this raises the question of policy with respect to expenditures of public funds

for rehabilitating forest lands in private ownership. Proposals for expenditures of public funds for forest rehabilitation and development inevitably bring up two other questions: Can we as a Nation afford it? Will it pay? Answers depend in part on the national income, the role forests play in it, and the role they can be expected to play.

Defined as the net value of production, or the money equivalent of goods produced and services rendered, total national income from all sources was approximately 80 billion dollars in 1929. Certain benefits from forests—the extent to which inspiration increases the earning capacity of individuals and communities, for example—cannot be measured in terms of cash. Aside from such intangibles, however, about 3 billion of the 80 billion of national income in 1929 came from wood products of all kinds, plus water conservation and livestock and wildlife production definitely dependent upon forests and forest lands.

Evaluating contributions forests can make after rehabilitation and development are effective is difficult. The evaluation must be based on certain assumptions that will in the course of years be subject to many influences and interpretations. An evaluation cannot therefore be made within narrow limits, but it can point to possibilities and probabilities inherent in forests as a means of helping unemployment and underwriting a permanent and a more prosperous civilization.

Evaluations indicate that the national income from forest lands and forest products can be raised over a period of years from 3 billion dollars to about \$5,400,000,000 a year and that this increase in future income may be made possible by a program of forest restoration, rehabilitation and acquisition that might involve a total investment of about 4½ billion dollars plus, ultimately, about \$100,000,000 annually for administration, protection, research, upkeep, and overhead.

Restoration, rehabilitation, and (p. 27) acquisition could probably be accomplished, with the investment indicated, within a 20-year period. On a yearly basis the above investment would amount to 225 million dollars.

Is there any question about the Nation's ability to afford an annual investment that approximates only about 11 percent of America's retail purchases at corner drug and cigar stores each year, one that totals less than 3 percent of her annual retail sales of automobile and accessories, one that, applied to an agricultural population in need of part-time jobs, bids fair to provide constructive work for 200,000 to 300,000 people each year for 20 years—workers who, with dependents, represent 800,000 to 1,200,000 people?

Is there any doubt about an investment that, with the amount needed for protection, management, research, and upkeep, bids fair after results become fully effective, to provide permanent work for 1,000,000 more people than in normal times have been employed in our forests and forest industries?

Underwriting a Civilization

CIVILIZATIONS the world over are dependent on land and water. If nations are to be permanent these basic resources, and the living ones from which they spring, must be used wisely and well.

The forest is one of these resources. It can be used but renewed; it can contribute to secure, stable, and prosperous civilizations. But forests can also be abused. They can be so badly misused that land itself is laid waste and made nonproductive, that springs go dry and floods ravish lowlands, that social structures decline and families and communities must move on and on as did nomads of old.

In the early Mediterranean civilization forests were abused. History records the decline of that civilization, to which all the world is heir and debtor in much that is worth while in agriculture and the arts. And it has been said that the chief causes of that decline were deforestation and denudation of hillside soil rather than changes of climate or attacks by barbarians.

Our forests have also been abused. Instead of being cropped they have been mined. But nature has on the whole been kind to us. We still have 630 million acres of forest land. This still grows forests of some kind, or forests can be restored on it. On the whole it is and probably always will be more valuable as forest land than for any other purpose. It is, and with care we believe always will be, enough land to serve our forest needs even though 168 million acres of it, vital in such matters as watershed protection and recreation, must from the standpoint of forest products be written off the national ledger.

But although we still have enough forest land, we need on it more and better forests. For they will help provide more jobs and steadier ones, will in this and many other ways help underwrite a permanent and a more prosperous civilization.

A Forest Inventory

THE forest survey indicates that we have more forests than we thought we had, and more forest growth—enough of the latter so that total growth of all species and sizes for the whole country probably comes much closer than we previously thought to total annual drain from all causes.

But the survey also indicates that the annual drain with respect to species and sizes commonly cut and used, in many regions and for the whole country, is still much greater than annual growth. It indicates, too, many localities where forest exploitation takes heavy toll in human exploitation; others where the resource is so depleted that

forest industries—on which communities depend—must be materially curtailed; other regions where the long-haul pattern militates against that demand which forest industries want and need.

Since the forest survey was started in 1930 it has covered in the field more than one-half the total forest area of the United States. Three-fifths of the information has been compiled, analyzed, and interpreted.

The forest survey is not yet completed but enough progress has been made within certain important forest regions or parts of them so that public and private agencies, industries, and individuals can get—as they are getting—authentic and up-to-date data on the basic resources there. It is impossible to go into details here, but high lights of certain forest regions or parts of them, presented in the next few pages, indicate the current forest situation and what can and must be done there if forests are to help as they should to increase the wealth of the Nation.

THE COLUMBIA RIVER BASIN

In Washington, Oregon, Idaho, and Montana, including about three-fifths of all our remaining old-growth timber, forests rank high as an existing and a potential asset. The two main forest regions here are so different that conditions and problems can best be understood if they are treated separately.

The West Coast.—The West coast embraces the heart of what is called the Douglas fir region. It lies in the western half of Oregon and Washington and has close to one-third of all the remaining saw timber in the United States. Field work by the forest survey is completed here. Its figures indicate a total saw-timber stand of 62.3 billion board feet, one-half of which might be operated at a profit under 1925–29 conditions, two-fifths at an estimated loss of \$5 or less per thousand feet, with the remainder still further out of reach commercially.

This region is a work reservoir as well as a forest reservoir. More than 50,000 forest and forest-industry workers are ordinarily employed. On the basis of national averages, their wages support nearly one quarter of a million people.

Five-sixths of the area is forest land, of which 51 percent is privately owned and 49 percent publicly owned or managed. Commercial conifer land totals 25.8 million acres. About 11 million acres are in old growth, producing little if any net increment because natural losses offset growth. About 10 million acres are in growing forests not fully stocked. About 4.4 million acres, once forested and still chiefly valuable as forest lands, are now practically unproductive.

Current annual coniferous growth is computed at 2.7 billion board feet. Annual drain is computed at 9.5 billion board feet. Annual

drain is, therefore, about three and one-half times annual growth. For the region as a whole this might not be so bad, but in the 6 most populous and highly industrialized of the 11 forest survey units the local situation is becoming serious.

Indications are that if cutting practices still generally followed in these units are continued there, old-growth fir will be gone long before new growth is ready for manufacture into lumber of sufficiently high quality to compete successfully with that which can be cut, at that time, in other localities. If the history of the Lakes States and other regions is any criterion, this means most forest industries now operating on old-growth Douglas fir in these six units must quit or, if there is room for them, move elsewhere. Unless something else intervenes this means want and misery for many an already established family and community.

Of the 14.2 million acres of privately owned commercial forest land, about 12.6 million acres are in what might be termed industrial and other (but not farm) ownership. Recent estimates indicate extensive forestry with sustained yield is practiced on about 3 percent of them, and extensive forestry without sustained yield on another 13 to 14 percent. This represents progress. But on nearly 8 million acres of forest lands in industrial and other (not farm) ownership, though they are in more or less productive condition, the owners make little if any effort (other than fire protection) to increase or improve forest capital or to relate mill capacities to the power of the land to produce forest growth. Practically all commercial forest land gets fire protection, but the area in private ownership burned between 1932 and 1936 was four times as much as that set as requisite for successful forestry practice.

The West coast region still has vast stands of old-growth forests. Real progress has been made there in fire protection. By some industrial and other owners, and on part of their lands, real progress has also been made toward sustained yield. Credit is due these owners. Despite competition from a far greater number of less-progressive neighbors, they are now redeeming, in whole or in part, obligations inherent in all forest lands no matter who owns them. But the need for more progress is still acute, for a big majority of private owners are still geared to quick liquidation; the stability—the existence, even—of many communities is still at stake.

The Interior.—The ponderosa pine type borders the Douglas fir region on the east. Forest-survey data in regard to it is now available for eastern Washington and eastern Oregon, to which the following applies.

Total saw-timber volume is estimated at 143 billion feet, board measure; ponderosa pine at 92 billion. About one-third the area is forest land. Of this, 68 percent is public and 32 percent is private property. Ownership is fairly stable. Commercial forest land now

idle because of cutting or fires, or a combination of these and other causes, totals about 534,000 acres.

Of the 13.5 million acres of privately owned commercial forest land all but 0.7 million acres are in industrial and other (not farm) ownership. Investigations indicate that sustained yield is not yet practiced on these lands on any extensive basis. Extensive forestry without sustained yield is, however, practiced on almost 9 percent of them. Some 5 million acres of commercial forest lands industrially and otherwise (but not farm) owned, though they now have fire protection and are in more or less productive condition, receive no special effort from owners to improve forest capital or relate mill capacities to the power of the land to produce forest growth. Practically all privately owned commercial forest land, in farm as well as in industrial and other ownership, now receives fire protection.

Current annual growth of saw timber is calculated by the forest survey at 363 million board feet; annual saw-timber drain at more than 2 billion. In general, ponderosa pine is naturally susceptible to management on a sustained yield cropping basis through selective cutting light enough to assure continuous operations and stability for communities. But selective cuttings as heavy as those now practiced on most privately owned forest lands, and a current annual saw-timber drain that exceeds by about fivefold the current annual saw-timber growth, are warning signals that cannot be ignored.

The situation near Bend, Oreg., is an example in point. This example is chosen because Bend offers a striking illustration of a community that, unwilling to take its forest resource for granted, has studied the situation and initiated courageous and constructive action.

In 1910 Bend was a picturesque frontier town of 536 people. It had nearby attractive ponderosa pine forests and good timber relatively close to main-line railroads. If cropped, this was capable of yielding continuous returns and permanent jobs for all time.

By 1930 Bend had become a hustling, hospitable, modern city of 8,848 people. There were some 12 small sawmills close by. At the city's edge were two huge five-band mills. They had a combined rating of 487 million feet per year on a three-shift basis. This was out of all proportion to the power of the land owned and controlled by these two big mills to grow forest crops for continuous harvesting. So was their 1937 cut of approximately 240 million feet; so much so that, at that rate, forest property owned and controlled by one mill might of itself last 8 years; that owned and controlled by the other 14 years.

Small sawmills near Bend are also on a cut-out-and-get-out basis. Four-fifths of Bend's population is dependent on local forest industries. So are schools, churches, and private property that, exclusive of sawmills, is valued at some 5¼ million dollars. Security and stability—continued existence perhaps—of all these things are at stake.

There is nonoperating forest property near Bend. Some 38 percent of it may soon be liquidated by a mill placed elsewhere. Timber held by other nonoperating owners is in large part subject to liquidation pressures. It, too, is accessible to sawmills other than the two big ones.

There is also public timber—national-forest timber—nearby. It is not subject to liquidation pressures, is ready for harvesting, is tributary to Bend's two big sawmills, and can be sold. When sold it must be harvested on a sustained-yield basis. Managed thus, with nearby privately owned forests similarly managed, it could go far toward solving the problem. But existing legislation requires that when national-forest timber is sold it shall go to the highest bidder. The purpose is to protect public interests. It is, therefore, possible—and not improbable—that a highest bidder might manufacture this national-forest timber elsewhere.

After an investigation a committee from the Bend, Oreg., Chamber of Commerce reported:

Unless operations in the timber tributary to the Bend mills are placed on a sustained-yield basis, the future of the community dependent on those mills is uncertain * * * [and this will cause] * * * great suffering and financial loss * * * among all classes of the local population.

Your committee believes that the losses that will be suffered if no sustained-yield program is arranged, and the benefits to be secured for every citizen of Bend by the consummation of a sustained-yield program are such as to call for the exercise of every possible effort on the part of the community to bring it about.

Bend is not an isolated case. Lakeview, Oreg., is also apprehensive, and as time goes on there will be many others. Bend's Chamber of Commerce recommended, in brief—

That every effort be made to secure the enactment of (1) Federal legislation making sustained-yield contracts possible, and (2) the appropriation of funds for the purchase program in the local timber area.

If public interests are to be safeguarded, there is need for both these things. The former is discussed on page 19; the latter on page 27.

THE LAKES STATES

In the West coast region (p. 8) total saw-timber stand is estimated at 628 billion board feet. In Minnesota, Wisconsin, and Michigan, to which the following applies, forest-survey data indicates a total saw-timber stand of 57.6 billion feet, board measure. Of this, Minnesota has 12.5 billion, Wisconsin 16.6 billion, and Michigan 28.5 billion.

Forest area in these three States occupies approximately 45 percent of all land surfaces. It totals 56 million acres and is about equal to the productive forest area of either Sweden or Finland. Approximately 90 percent of all land is in public, and 60 percent is in private, ownership. Its potentialities are great because of proximity to huge indus-

trial and agricultural centers of population, including the Middle West and the high productivity of the land as indicated by its original forest.

But 11.2 million acres of forest land have been so abused that they now have no merchantable timber, and reproduction of commercial forest species occupies less than 10 percent of its surface. This means pretty thorough denudation of valuable forest growth. Another 18 million acres still bear merchantable timber, but far too little of it is mature. In these Lakes States generally there is too little advanced second growth to insure, under anything like present practices, sustained production of high-grade wood in the near future.

Lakes States white pine was once characterized as an inexhaustible forest resource. This region once produced its own requirements and dominated huge Midwestern markets. With current conditions as described, and with annual growth of saw timber computed at 1.8 billion board feet a year and annual drain at 2.4 billions, there may in the next few decades be an even greater shortage of certain species and qualities than is indicated by the fact that people there now import—largely over long and costly hauls—two-thirds of the lumber they use.

There is real need to rebuild forest lands and rehabilitate existing forests here. This could provide immediate work for people who need it. It could also provide more forest and forest-industry jobs in years to come. There is also urgent need to conserve existing supplies of merchantable timber, and the jobs they represent; to keep saw-timber drain below rather than above annual growth; to tide industries and dependent families and communities over until second growth becomes large enough for use.

Yet, of the nearly 16.5 million acres of Lakes States forest land in industrial and other (not farm) ownership, less than 100,000 acres (or 0.5 percent) are now under intensive forest management including sustained yield, and less than 1 million acres (5 percent) are under extensive forest management without sustained yield. Approximately 15.5 million acres (94 percent) are now in more or less productive condition, but except for providing fire protection no special effort is made by the owners to improve forest capital or growing stock. And on some 36 million acres of private forest lands—those in farm as well as in industrial and other ownership—protection from fire is only 50 to 75 percent adequate.

THE SOUTH

Generally speaking, the South (p. 3) includes 14 States. To relate to it current forest survey data now available, the South as here referred to includes, unless otherwise defined, a gross land area of some 213 million acres; all but small unsurveyed parts of Georgia

and Florida; all of Alabama, Mississippi, Louisiana; parts of South Carolina, Arkansas, Oklahoma, and Texas.

Despite 2 centuries or more of cultivation for such things as indigo, rice, sugar cane, and cotton, each of these States except Texas and Oklahoma still has more land in forests than in all other uses combined. Florida leads, with 71 percent forest land. Mississippi, though it trails, still has 54 percent. The average is 59 percent.

Next only to cotton, the South's forests have been her greatest single source of wealth. For more than 200 years they have supported industries producing such commodities as lumber, naval stores, poles, and piling.

The South as defined still has 125 million acres of forest land, but forests on most of it have been cut, slashed, and mined. Some 9.5 million acres are now so nearly devastated that they must be planted in order quickly to grow worth-while forests again. About 97 million acres bear second growth, but only half of it has trees of saw-timber size and most of it is seriously understocked. Of 18 million acres now in old growth, 11 million acres have been culled.

Despite all this the forest survey shows 264 billion board feet of saw timber and, in merchantable trees under sawlog sizes, 454 million cords of rough wood. Of the former, 56 percent is pine, and 44 percent (including cypress) is hardwoods. Of the latter, 34 percent is pine, and 66 percent is hardwoods. This forest resource is one of the South's most precious assets. Nature has been so kind that total annual forest increment (growth less natural mortality) of all species and sizes—computed at 48 million cords—exceeds the total annual commodity drain by some 7 million cords.

This figure can, however, be misleading. Much growth is in sizes unavailable for current use. Much is in low-grade hardwoods for which there is less demand than for pines. Rate of increment in the 35-million-acre naval stores area is only about half what it is in other pine regions. In the South as defined there were in 1936 more than 8,200 sawmills and 900 other wood-using plants. Current saw-timber drain exceeds by 1.25 billions of board feet the computed saw-timber growth of 13.25 billions of board feet. Certain areas are now reaching the point where some industries must be materially curtailed because of unwise use of the forest. In all the Southern States together, 15 new pulp mills have been established within the last 3 years. This makes a total of 45. These mills alone may require 5 million cords of rough wood annually.

So, though in the South as defined total annual forest growth of all species and all sizes exceeds total annual drain by 7 million cords, the picture is not too rosy. For although fire protection has been extended, and reforestation has increased in recent years, many southern forests have produced and grown without care from man and largely in spite of his indifference and abuse. Now old-growth and saw-

timber stands are in general understocked. Yet from analyses made in many forest survey units of some 6 to 10 million acres each, it is known that forest growing stock in the South generally can be built up; that annual increment can be doubled, at least.

This is significant. It is estimated that in a single year forest industries in the South as a whole have provided work for about 225,000 people. If, through doubling increment, forest employment over the years could also be doubled, work might be provided for 450,000 individuals. In the South, forest and forest-industry payrolls might then support more than 1,800,000 people.

No one can now say with certainty that this can or cannot be done. It seems pertinent, however, to record that one pulp mill in Florida is to produce southern pine sulphite pulp for use in rayon-pulp manufacture and that part of the production of a new mill in Louisiana is planned for bleached sulphate designed for use in rayon pulp. It may also be significant that although plant capacity for world production of chemical pulp is reported to have increased nearly 3,000,000 tons in the last 2 years, only 52 percent of this increase was in the United States; and that a new pulp mill in Louisiana, running to capacity, will, it is estimated, require (in mill and woods) more than 800,000 man-days of labor each year. This—for one pulp mill only—is equivalent to 250 days of work for 3,200 people. And in the entire South there are 45 pulp mills now, and there were in 1936 more than 8,200 sawmills and 900 wood-using plants.

Nature, prodigal as she is, must be aided by man before southern forests as a whole can double their present growth. Fortunately most of the things man must do are obvious and rather simple. Adequate fire protection, for example, must be provided. The forests must be cropped rather than mined. It must be made to produce a wide variety of forest products. Growing stock must be built up. And these things must be done on all forest lands, no matter who owns them.

Progress has been made. Many private owners as well as States and the Forest Service have demonstrated that fire protection and better forest practices will increase growing stock and annual increment and that these things can be done at a profit and will leave forest land in far better growing condition. But recent investigations indicate that intensive forestry, technically speaking, is confined to relatively few forest properties in private ownership in the South as defined on page 12; that although extensive forestry without sustained yield is now practiced on perhaps about one-quarter of the 12.5 million acres privately owned there, only a small proportion of all forest operators in the South can—except that they provide for fire protection—be included in these categories.

Investigations also indicate that (1) on some 23 million acres of the privately owned forest lands now in more or less productive condition

no effort other than supplying fire protection is made by the owners to increase or improve forest capital or to relate mill capacity to the power of the land to produce forest growth; and (2) on some 72 million acres, or 60 percent, of all privately owned forest lands in the South (as defined) adequate protection from fire is still lacking.

It seems evident that the South still stands at the crossroads.

Except with respect to the character and extent of operations on privately owned forest lands, analyses—highlighted on previous pages—of current forest conditions in certain regions are based on the work of the forest survey. These analyses—and more detailed data now in constant demand by industries and individuals, State and county planning boards, public and private agencies generally—illustrate the need (1) for completing the forest inventory, and, as is done in Sweden and Finland, (2) for keeping it up to date.

The President's Message

ON March 14, 1938, the President addressed to Congress a special message¹ about forests and forest lands. "I feel impelled at this time," he said in part, "to call to the attention of the Congress some aspects of our forest problem, and the need for a policy and plan of action with respect to it."

Human needs form the keynote of this message. "Forests," it says, "are intimately tied into our whole social and economic life * * * and some way must be found to make forest lands and forest resources contribute their full share to the social and economic structures of this country, and to the security and stability of all our people."

This approach is broad, democratic, and realistic. The message recognizes progress in private, State, and Federal forest practices, but it also recognizes that measures so far undertaken do not adequately meet the current situation. The President recommends study by a joint committee of the Congress itself; a study he hopes "will form the basis for essential legislation during the next session of Congress." He states, unequivocally, that "The public has certain responsibilities and obligations with respect to private forest lands," but adds, "so also have private owners with respect to the broad public interests in those same lands."

There is need, the President believes, to review methods of and opportunities for employment in forest work. Particular consideration, according to the Chief Executive, might well be given to cooperative relationships with private owners of forest lands and "cooperative efforts between the Federal Government and the States"; to "the need for such public regulatory controls as will adequately protect private

¹ Document No. 539, 75th Cong., 3d Sess.

as well as the broad public interests in all forest lands"; to "extension of Federal, State, and community ownership of forest lands, and planned public management of them."

A Forest Policy

WE now have within the continental United States some 16 million acres of noncommercial forest land and (p. 1) about 462 million acres that are commercial. Despite all that has happened, it seems probable that as a nation we need no more forest land now, and may not need more in the years to come. But we do need more and better forests. There is, therefore, need for a forest policy recognizing:

1. That on the whole this 630 million acres is and probably always will be more valuable in forest than in any other use.

2. That this 630 million acres must be adequately protected against damage or destruction by fire, insects, diseases, and quick liquidation.

3. That on this 630 million acres adequate forest and other cover must be restored where necessary, and maintained.

4. That on part of it—the 462 million acres of commercial forest lands—growing stock and productivity must be built up and maintained.

5. That though interests of private owners who comply with the Nation's forest policy must be protected, so must public interests inherent in all forest lands; that in private and public welfare there must be full and continuous use of all products, values, and services of forest lands and their resources can and do render locally, nationally and through world-wide markets.

6. That research—including research in utilization and economics in particular—is essential to full and continuous use, and must be planned and executed as to help make the many wood products and byproducts of wood easily and readily available to consumers generally.

7. That since the forest resource is inextricably bound up with use of land for other agricultural purposes, forest management and use are integral parts of a unified agricultural pattern that must contribute fully and continuously to local and national social and economic structures.

A Plan of Action

THE plan of action proposed in the President's special message (p. 15) is based on those human needs without which forest utilization is impossible and forest conservation meaningless. Its essentials are (1) public (State and Federal) cooperation with private

owners; (2) public regulation of forest land; (3) extension of public ownership and management.

PUBLIC COOPERATION

Public cooperation has to do with forest lands in private ownership. Of all commercial forest lands, those in private ownership total the best 341 million acres and constitute 90 percent of all potential forest-growing capacity. About 202 million acres are in industrial and other (but not farm) ownership. The rest, some 139 million acres, are farm forests.

If these forest lands are to help as they can and should to increase national wealth, and if private ownership of them is to continue, owners must conform to the Nation's forest policy. But as private responsibilities are recognized and redeemed, so also must those of the public be redeemed. Among these responsibilities are:

Protection.—Forests are subject to attacks by insects and diseases. These attacks sometimes do enormous damage. Control measures have been under way for years. Most funds have been Federal funds, often inadequate to accomplish the work on Federal lands alone. Neither forest insects nor forest diseases recognize property lines. When epidemics are threatened and when they occur, work is necessary on lands in private as well as in public ownership. Funds should come from both sources.

Forests are also subject to damage and destruction from fire. Lightning sets forest fires, but a great many are man-caused. Some start from logging; others from camping, hunting, and fishing by the public. Others are of incendiary origin. Besides protecting their own forest lands from fire it has, therefore, become a function of States to help private owners protect theirs, and these efforts have been supplemented on a cooperative basis by Federal funds.

Besides preventive measures, adequate forest-fire protection involves building and manning lookout towers so fires may be detected quickly; installing and maintaining telephone lines and radios so fires may be reported at once; constructing and keeping up roads, trails, and landing fields, and planning transportation, tools, and supplies so organized suppression crews may attack fire without delay.

In 1924 Congress authorized not more than 2½ million dollars to encourage and assist cooperative fire protection on lands in private and State ownership. The first Federal appropriation was made in 1926—\$660,000, with \$638,427.59 expended for this purpose. Recorded public funds expended for organized fire protection by the States reached \$1,611,380.61 that year. Those reported by private owners were \$263,512.58. Of the \$2,513,320.78 total, expenditures by private owners therefore constituted 10½ percent; those by public agencies, 89½ percent.

In the fiscal year 1938, expenditures by States for cooperatively organized fire protection were \$4,013,876. Those authorized under the (Federal) Clarke-McNary law were \$1,610,000. Those reported from private owners reached \$1,433,671, or about 20 percent of the total. There were additional unreported private expenditures, and the public expenditures mentioned do not include the fire-protection work done by the Civilian Conservation Corps on private and State-owned forest lands. As of March 31, 1938, this included construction of 38,937 miles of firebreaks, 1,020 lookout towers, 274 lookout houses, 28,787 miles of telephone lines, and 45,118 miles of trails and truck trails. The Civilian Conservation Corps also put in 472,273 man-days fighting fire on State-owned forest lands, and 1,068,627 man-days on forest lands in private ownership.

Real progress in fire protection has been made during the last 12 years. In 1926, 178,232,000 acres of private and State-owned lands were under organized fire protection. In 1937 the area reached 301,911,350 acres. In 1926 the number of fires reported on lands in State and private ownership was 87,190, with 23,539,500 acres burned over. In 1937, with 175,741 fires reported, the area reported burned was held to 21,890,730 acres. But 69 percent of these 1937 fires and 94 percent of the area burned were on some 182,762,920 acres still outside organized protection districts. On protected areas performance was excellent within some States, but records show it is not yet adequate within many organized districts in a number of States.

Reasonably adequate fire protection for all the 420,000,000 acres of private and State-owned forest lands needing it may require some 18 millions of dollars annually. This is equivalent to 4.3 cents per acre per year. It calls for increases in Federal as well as in State and private expenditures.

Forest Credits.—Credits for industry have in the past been derived from private sources. Lately these credits have in large measure dried up. This has raised the question of public or publicly sponsored credits like those available through the Farm Credit and Federal Housing Administrations and the Reconstruction Finance Corporation.

In general private credits to forest industries have tended to force quick liquidation of the basic forest resource. This has not made for the public welfare. There is need for public or publicly sponsored credits definitely adapted to forest industries. These should embody relatively long periods of time and low interest rates, and might logically be extended to owners who operate in accordance with national policies designed to protect the forest resource. Modeled along farm-credit lines, and with provision for administration by an accredited Federal credit agency, such legislation should form an integral part of a progressive program of public cooperation.

Taxation.—The property tax as applied to forest properties, in combination with liquidation policies, often brings disaster. As time goes on the tax base narrows, the rate goes up, liquidation is accelerated, owners and local governments commit suicide together.

In brief this has been the background of the property tax as applied to forest lands. Various modifications have appeared and have been adopted in a number of States, but from one standpoint or another all of them are open to serious objection.

Timberland taxation is a problem primarily within jurisdiction of State and local governments. It may be assumed that they and owners of forest lands will best be protected by taxation so applied as to encourage building up and maintaining forest productivity and continuous returns. One difficulty in getting such taxation lies, it seems, in the widespread policy of quick liquidation. So far, taxing agencies have been inclined to get while the getting was good. This has too often resulted in distress both to owners and to the public.

Equitable solution of forest-land tax problems depends on private owners acting in conformity with the Nation's forest policy. It also depends on a constructive approach on the part of private owners and mutual confidence between them and taxing authorities. It is inconceivable that owners who approach State and county authorities with a workable plan for sustained-yield forest management and who convince those authorities that they can and will operate on such a basis, should not get a square deal. Certain owners have tried this. They and local public agencies have found such procedures satisfactory. Both have expressed confidence in the future.

Unity of Management.—There are many regions in which the remaining forest resource is now partly in public and partly in private ownership. Within these there are many localities (p. 11) where unity of management can help to keep more ghost towns from coming into existence and can contribute security and stability to established and dependent industries and communities.

Legislation before the last Congress recognized this. It defined a method for pooling public and private timber provided the latter and the former were so managed as to insure compliance with the Nation's forest policy. To safeguard public interests it made appraisals and publication of them mandatory. Guaranteeing public hearings and the right to appeal, it also provided that public timber might be allocated to other than the highest bidder.

In this a choice was necessary. Forest resources in public and private ownership within a natural unit cannot be managed uniformly under a long-time plan without mutual concessions. It appears in the public interest for the Forest Service to concede certain orthodox procedure, and to be in position after appraisals have been made and published to reject the highest bid where such action will assure continuity, security, and stability to established and dependent commun-

ities within the unit. This concession on behalf of public interest should, however, be contingent upon definite, legal, and enforceable commitments by private owners, commitments assuring compliance with the Nation's forest policy.

Farm Forests.—Including noncommercial forest lands, there are approximately 185 million acres of farm-owned forest lands in continental United States. Annual yield from them is equal in value to the combined crops of barley, rye, rice, and flaxseed, and nearly equal in value to the tobacco crop. In 1934, farm forests contributed 63 million dollars in cash to more than 2½ million farm families, and 54 million dollars worth of such farm-used products as fuel wood and fence posts.

Like forests in industrial and other nonfarm private ownership, most farm forests have been abused; they do not now yield as they should. Unlike most industrial forests, most farm forests are in small units. Rebuilding and harvesting them are forest problems, but as essential parts of farm management these problems must be worked out through Federal, State, and local agricultural agencies and in cooperation with State foresters.

Congress recognizes that farm forests require special treatment. In addition to Federal assistance in fire protection, the Clarke-McNary law, passed in 1924, authorizes Federal cooperation with States to produce and distribute trees for planting by farmers. It also provides for farm-forestry extension and for investigative work in forest-taxation problems.

The calendar year 1937 saw 41,698,000 trees produced and distributed, with help from Clarke-McNary funds, in 40 States and 2 Territories, and 50,987 acres were planted. In farm-forestry extension the Forest Service cooperated with and gave assistance through the Extension Service and State agricultural colleges in 37 States and 1 Territory, employing 48 forestry specialists. Field demonstrations and meetings totaled 9,031.

Under its 1938 agricultural conservation program the Agricultural Adjustment Administration sets up a soil-building goal for each farm. Among ways of earning credits toward attaining this goal are (1) planting forest trees (and shrubs in protective plantings) provided they are protected and cultivated in accordance with approved practices, (2) caring for trees and shrubs planted between January 1, 1934, and January 1, 1938, and (3) with the prior approval of the county committee, properly managing existing farm forests. This program is exceedingly helpful. In some regions (the Lakes States, for example) it appears as if credits might be more widely applied for proper management of forested portions of farms.

In 1937 Congress gave added recognition to the vital part farm forests play in our agricultural economy, and to the need for special treatment for them. It recognized, too, fundamental differences be-

tween establishing, maintaining, and handling farm forests in areas where forests grow naturally, and in areas like the Prairie States. So the Norris-Doxey Act, which carries an authorization of 2½ million dollars, was made broad enough to permit Federal cooperation and aid in establishing shelterbelts and farm wood lots.

Techniques of shelterbelt planting in the Prairie-Plains region are forestry techniques, but the project itself has primarily to do with farm security. More than 200,000 farm families live in this region, and farm land and its improvements here are valued at more than 3 billion dollars. Experiences with old plantations indicate that farm wood lots and shelterbelts have helped materially to conserve soil moisture and increase yields of cultivated crops, prevent destruction of topsoil by wind, provide sorely needed shade and shelter for farm families and livestock, and furnish such products as fuel and fence posts. Records indicate that some lending agencies prefer to have shelterbelts on farms of Prairie Plains borrowers and lessees as greater surety for mortgages and leases. Some Federal land banks are urging shelterbelts on Prairie Plains farms taken over by them.

There was no appropriation for the fiscal year 1938 under the Norris-Doxey Act but the shelterbelt project was, with its relief features, continued with emergency funds. In cooperation with farmers who shared costs through contributions of labor, cultivation, fencing, and use of land, some 4,264 miles of shelterbelt strips were set out in six States. This involved planting 39,255,300 trees, shrubs, and nuts, including replacements. Because of better moisture conditions average survival should exceed the 65-percent drought-year results. As of June 30, 1938, some 60,000,000 seedlings were growing in nurseries for next year's planting.

In certain parts of Hungary upright wooden lattices are used to provide shelter, prevent desiccating winds from robbing the soil of moisture, and increase the yields of crops. In the Prairie-Plains States since 1935, and despite drought, grasshopper plagues, and dust storms, nearly 7,000 miles of new shelterbelts have been established. They are capable of protecting 2 million acres of cropland. Growth in some cases has exceeded 25 feet in height during the first 3 years.

Methods of planting these living lattices have been worked out and applied by foresters, but the project itself is one that primarily concerns farm security.

Research.—Scientific information is essential to successful management of forest and other wild lands and their resources so they may return greatest values and services. As conducted by the Forest Service, research has primarily to do with forests, forest management, forest economics, and uses and markets for forest products. It is applicable to forest lands in private as well as public ownership. Findings and results are available to individuals, industries, and public and private agencies generally.

Research in forest management seeks how best to protect forests from fire, insects, and diseases; it lays foundations for tending forests, and for regenerating them naturally and artificially. It includes study and determination of improved methods of fire detection and control, and methods and means of growing, managing, and harvesting forest crops, including farm wood lots, pulpwood, and naval stores.

Economic aspects largely determine the extent to which good practices can be applied to farm forests, public forests, and those in industrial and other ownerships. One basic project in forest-economics research is the (p. 7) forest survey. Others concern forest taxation, tax delinquency of forest lands, forest fire insurance, land-and-resource utilization to help stabilize dependent industries and communities on the basis of permanent land-and-resource management, analyses of economic aspects of timber growing and harvesting, methods of organizing and operating cooperative farm wood lots, stability of ownership of forest lands, financing forest industries, and methods of marketing forest products.

Natural resources do not of themselves make a nation great, or a civilization secure. The modern economic order rests in large part on the ability to command gifts of nature and apply them to ever-increasing human needs. Research in forest products seeks to make existing methods of utilization more efficient and forest products cheaper, more diversified, and more satisfactory. It also pioneers in new fields of utilization.

Since they are essential to the basic problem, the Forest Service also conducts research in (1) matters having to do with plant cover in relation to water flow and erosion, and (2) others concerning the use of grass and browse, which occur in combination with timber and on the higher portions of many major watersheds. Research in the former includes intensive studies of the absorptive capacities of forest and other soils; the effects of misuse of land on run-off, and of wind-breaks on air movements, temperatures, soil moisture, and crops. Range research determines when and how range lands can be grazed without injury to plant cover and soil; it helps determine forage values, grazing capacities, and range-forage-utilization standards; it aids to restore and rebuild depleted ranges and abandoned farm lands.

Research activities are directed through 12 forest experiment stations and the Forest Products Laboratory. They extend to 93 experimental forests and ranges that serve as outdoor laboratories and demonstration areas and to 33 natural areas. Many results of research may be seen on the various demonstration areas. Others are available through publications. Because of the size, scope, and importance of the many problems involved, the facilities now available are no longer adequate.

PUBLIC REGULATION

Among rights declared inalienable by delegates to the Continental Congress were those of life, liberty, and the pursuit of happiness. This is the foundation upon which a new Nation was built. In social as well as economic aspects these things form the framework of what we accept as the democratic way.

Civilization is more complex than it was in Thomas Jefferson's time, but liberty is just as precious. It is still necessary to safeguard it; yet we have learned that restraints are often necessary. Zoning offers one example. It restrains liberty but protects both the individual and the community.

Forests in the continental United States once grew on about 820 million acres. For more than 300 years they helped a young Nation expand, prosper, and mature. Lands capable of growing marketable timber now total 462 million acres. The best three-fourths is in private ownership, as is nine-tenths of all potential forest-growing capacity. Private ownership holds the key, therefore, to the welfare of millions of people who depend on forest resources, and on water from forest-covered slopes for irrigation, power, and domestic purposes.

Much more privately owned forest land is now under organized fire protection than was the case a decade ago, and protection is on the whole much more effective. Some private owners are leaving recently cut-over lands in better growing condition. In many regions a limited number of them are getting profitable yields more nearly in line with the power of the lands to produce adequate and continuous returns. These are the leaders. They are making real efforts to redeem their public responsibilities.

Private initiative and public cooperation have brought a measure of progress. The former should be encouraged. Under proper safeguards the latter should be increased. But the President's statement that these things "are not adequate * * * to meet the present situation" (p. 15) is justified. So is his suggestion that a joint Congressional committee give "particular consideration" to the needs for public regulatory controls with respect to privately owned forest lands. For the fate of the largest part of the best forest land in the United States is at stake. As a Nation we must adequately safeguard its productivity. To accomplish this, experience points to the need for exercise of a greater margin of sovereignty over it.

In the matter of traffic we welcome greater sovereignty. We have more safety and freedom with traffic regulation than we would without it. For years private owners of forest lands have sought and obtained public regulation to help prevent forest fires and to control those that start. In some States public agencies may suspend logging operations during heavy fire danger. In others, logging operations may be undertaken only under permits issued by a public agency. But as more

control of traffic is needed now, so is more control over private forest lands. It is needed in the public interest and to help protect leaders who, now cropping their forests, are subject to unfair competition from others who mine and exploit regardless of what values, or whose are at stake.

In last year's annual report public regulation was proposed as a vital part of the forest policy for the Nation. It excited interest and discussion. Majority opinion within forest industries is probably against it, though some progressive leaders believe it necessary and inevitable. Public opinion, determined that exploitation must be stopped, seems largely in favor of it.

Discussion of public regulation has been helpful. Among other things it has focused attention upon the need, in cooperation with States, for Federal regulation of forest lands. In support of this viewpoint, discussion brought out that forest products are intermingled in interstate and intrastate markets; that, irrespective of State lines, forests help reduce the height of such floods as that of the Ohio, which in 1937 affected people in 243 counties in 10 States; that forests help prevent wind erosion, and silting of reservoirs vital to millions of people who, in many States, depend on water for irrigation, for power, and for domestic purposes; and that forests help prevent silting of streams and harbors used in transporting agricultural and industrial products from large sections of the country to domestic and world-wide markets.

In the light of these discussions the whole field of public regulation of forest lands has been explored. Even though the principle seems generally accepted by the public, there are honest differences of opinion as to methods and procedures. This was to be expected. There is, however, general agreement that regulation must be sound, economic, and democratic in concept, and that it should come as a result of standards openly arrived at.

The belief is also prevalent that, reflecting local needs and conditions, those standards must protect Nation-wide values and services; that, conserving broad public interests, they must, as President Roosevelt points out, "adequately protect private interests [in those lands] as well * * *"; that forest-land regulation must be sympathetic and fair, firm but flexible, and so clear, explicit, and easily understandable that adequate controls can and will be secured in the woods.

Proposals with respect to public regulation of private forest lands generally will be placed before the joint committee for such study by it as may, to quote from the Chief Executive's message, "form the basis for essential legislation during the next session of Congress."

PUBLIC OWNERSHIP

The need for public ownership and management of forest lands was recognized when the national forests, then called forest reserves, were established. Federal ownership and management have been reaffirmed by the Weeks law, the Clarke-McNary Act, and legislative enactments in many States. State legislation and local ordinances also provide for forests owned and managed by States and communities.

Public ownership and management of forest lands is an established policy. The degree to which this policy may be applied is discussed on pages 27 and 28.

Community Forests.—According to reports in 1933 there were in the United States 860 forest properties owned and under some form of management by such political subdivisions as counties, towns, and cities. A recent check indicates at least 1,500 community forests now in some stage of development and management, in 20 or more States. The total area involved may exceed 3,000,000 acres.

Community forests protect water supplies, provide opportunities for inspiration and inexpensive outdoor recreation, improve hunting and fishing, and grow timber for municipal and other uses. Demonstrating that, managed on a cropping basis, the forest can be used for all these things, most of them illustrate essential differences between forests and parks.

Newington, N. H., with 381 inhabitants, boasts what is said to be the oldest community forest in the United States. Established in 1710, this forest has helped to build a church, a town hall, a school, a parsonage, and a library; provided part of the funds for the village water-supply system; helped pay the minister's salary; supplied structural material for bridges and other purposes, and fuel wood. This Newington forest contains only 112 acres. That owned and managed by Newark, N. J., includes 36,000 acres and has yielded more than \$17,000 worth of sawlogs, piling, fuel wood, and posts. An 800-acre community forest owned by Essex Junction, Vt., is said to show, now, a profit of \$3,000 on the original investment.

But one of the greatest values of community forests is the opportunities they afford for replacing a public dole by worth-while work. Town forests in Massachusetts, for example, have provided more than 1 million man-hours of relief labor in the past few years. By building up and improving the properties, this work has increased the services and values derived by the public from them.

State Forests.—Like community forests, organized State forests are generally managed on a multiple-use basis. They are, in this respect, distinct from State parks. Since most State forests are larger than most community forests, they are not quite so near large centers of population. They should, however, be so well and widely distributed

that the public will have ready access to them for hunting, fishing, camping, hiking, and picnicking.

Records indicate 41 States now have 800 organized State forests; that State-owned land within them totals 10,802,700 acres, and that they are becoming more and more valuable in and of themselves and as a means of creating widespread interest in good forest management. Congress recognized these values and the need for more State forests when in 1935 it passed the Fulmer Act. This authorizes Federal purchases to help complete State-forest systems, with reimbursement by States from funds received from the sale of products and use of the lands. Management, under approved standards is by the States. Since this act was passed, 32 States have qualified under it. The Forest Service has cooperated by helping to examine areas.

Federal Forests.—National forests are generally much larger than State forests and farther from centers of population. They are located on the flanks of the Appalachians from New Hampshire to Georgia, around the Great Lakes and headwaters of rivers like the Mississippi and Missouri, on the Great Smokies, in southern pineries on the slopes of the Rocky, the Cascade, the Sierra Nevada, and the Coast Ranges between Canada and Mexico.

Including slightly more than 1,000,000 acres approved for purchase in purchase units, the national-forest system (p. 32) as of June 30, 1938, comprised 175,238,168 acres of federally owned lands. Established irrespective of State boundaries, these public properties are distinct from national parks in that they are administered on a multiple-use basis, with renewal of all their resources and values.

Today's national forests offer striking contrasts between civilization and wilderness, industrial activities and pastoral, material values and spiritual ones. More than 1,280 million feet of timber was harvested from them, under provisions that assure continuity of the forest stand in the fiscal year 1938. They already provide a living for almost a million people and recreation for 30 million each year; are home and refuge for most of our remaining big game; include some 70,000 miles of fishing streams and more than 3,500 developed public campgrounds furnish forage for more than 6,857,000 domestic livestock; help prevent floods and erosion; and provide domestic water for 6 million city people. They have a public transportation system that includes more than 138,000 miles of highways and roads and 153,000 miles of trails. Gross receipts from the national forests in the fiscal year 1938 were \$4,671,133, with \$1,178,883 returned to the States.

The national-forest system is interstate in character and purposes. It is large, but there are many huge watersheds outside it that still need protection. With no real indication that private owners are willing or able to undertake the job generally, there are also millions of acres of devastated, tax-delinquent, and abandoned forest lands.

that need rebuilding so they may again support families and communities. There are also many areas within which existing forest industries and dependent communities are threatened by quick liquidation of the basic forest resource; where, unless preventive measures are taken soon, remaining forest resources may be so wrecked or crippled that they can only be restored largely at public expense. These conditions indicate the need for extending the present national-forest system.

Public Acquisition

THE extent to which public ownership and management of forest lands need be applied was analyzed in the Capper Report of 1920, and was also discussed in the Copeland Report in 1933. In 1934 it was analyzed again in the report of the National Resources Board. These investigations agreed on the need for a major program. There were differences of opinion as to the total area which should be acquired, but agreement that public ownership and management should embrace community forests, State forests, and national forests.

In 1937 another check was made. Confirming major conclusions of previous investigations and reaffirming the belief that in the broad public interests private ownership must be contingent on the compliance of owners with the Nation's forest policy, this check indicated 148,314,000 acres as the total of forest lands now in private ownership that should be acquired by public agencies generally. This is some 75,000,000 acres less than the Copeland Report figure and nearly 40,000,000 acres less than that suggested by the National Resources Board. It represents a long-time program.

The check indicates that, over the years, 47,950,000 acres might well be acquired principally as:

(1) Community forests. Such forests constitute a desirable form of public ownership and management.

(2) State forests. In most States a more adequate system of State-owned forests is needed. The Fulmer Act recognizes this in principle, but Congress has not yet provided the funds needed to make the act effective.

The check also indicates the need for a long-time program of Federal acquisition involving 100,364,000 acres for the national-forest system. Of this,

(1) 39,861,000 acres, now within national-forest boundaries, are essential and integral parts of existing and established national forests and purchase units;

(2) 19,550,000 acres, already examined, are vital to problems essentially interstate in character and scope. Reports on more than two-thirds of this acreage have been prepared for the National Forest Reservation Commission;

(3) 40,953,000 acres that, on the basis of the best data now available probably should be acquired.

In continuing this program priorities should as far as possible be applied as indicated above. Continuity without such interruption as have been experienced in the past will make for greater efficiency and economy. Break-down by broad regions of the proposed program for Federal acquisition is indicated on pages 33 and 34.

Federal ownership of forest lands inevitably raises the question of compensation to States and counties for loss of tax revenues. In the Federal Government has as yet no consistent policy. No compensation is made in connection with millions of acres of forest land in Federal ownership, yet 25 percent of gross receipts from national forests are returned to States and counties. This method of compensation is based solely on current income. It is unsatisfactory in that it provides little if any immediate return from lands that, cut heavily by private owners, have since been added to the national-forest system.

Compensation in lieu of taxes is a basic problem. There is urgent need for uniform application of a simple and direct solution that will provide—

(1) Current and stable income to counties within which there are forest lands that, previously wrecked or abused by private owners, are now being rebuilt and administered under Federal ownership and management;

(2) Additional revenues that will act as an incentive for communities and counties to help build up the productivity—on which such additional revenues shall be based—of the lands and their resources.

The Forest Service

THE basic purpose of forest conservation as a public policy is a social one. It relates to forest lands and their resources, but it does not consider trees, for example, as an end in themselves. It looks upon them as tools that, adequately maintained, help underwrite a permanent and a more prosperous civilization.

This, in brief, indicates responsibilities assigned by Congress through the Department of Agriculture to the Forest Service. Within this pattern its functions are to help make forest lands and their resources fully productive; to insure from them the maximum continuous services, products, and values that they are capable of yielding.

The responsibilities and functions of the Forest Service may be expressed as: (1) To initiate and apply, locally and nationally, action programs in the interest of public welfare and help with action programs initiated by county, State, and other Federal agencies; (2) to

protect, develop, and administer in the public interest the publicly owned national-forest system and all its resources, products, values, and services; and (3) to conduct research in problems involving protection, development, management, renewal, and continuous use of all resources, products, values, and services of forest lands.

Action Programs.—Some 95 percent of all the forest products we use each year come from privately owned forest lands. The best 74 percent of all commercial forest land is in private ownership. Many action programs administered for public welfare by the Forest Service, and many of those it helps correlate, coordinate, and apply, have heretofore to do with forest and allied problems involved in private ownership.

Some of these programs are summarized on pages 21 and 22. Others include (1) cooperation with the Agricultural Adjustment Administration in connection with the range-conservation program and in examining in 1937 some 50 million acres of western range; (2) administration of the naval stores conservation program to help conserve forest resources and provide better yields from some 65 million acres; (3) cooperation with regional, State, and county boards in planning for better land use; and (4) cooperation with private owners and Federal, State, and other public agencies with respect to forest problems on lands that they own or that are under their jurisdiction.

The National Forests.—The national-forest system already supports almost a million people; when more fully developed and used it will be capable of supporting many more. Certain problems, and the work of the Forest Service in protecting, developing, and administering the national forests, are described on pages 32 to 54.

Research.—To contribute the maximum in permanent returns, management of forest lands and their products must rest on sound technical and economic bases. This applies to forest lands in public and private ownership alike.

Research as conducted by the Forest Service has already been summarized (pp. 21 and 22), and these investigations and their results are correlated, throughout this report, with certain forest problems and the work of the Forest Service. The results of this research, available to public and private agencies, individuals, and industries alike, are now widely applied. But the demands for basic forest research have become so great that current facilities fall far short of what are needed.

Decentralization.—The Forest Service is a decentralized organization. Most of its 10 administrative regions, each in charge of a regional forester, were established almost two decades ago. Its 12 regional experiment stations and the Forest Products Laboratory, each in charge of a director, have been developed over a long period. The primary purpose has been to provide close and constant touch with current conditions and problems in the States and Territories. To insure sympathetic and understanding approach, regional foresters

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and directors act as consulting members of the Chief's staff in establishing broad policies and standards applicable to the Forest Service as a whole.

Performance in the field is checked through inspections and (p. 5) audits. Correlation and coordination are secured through special integrating inspections. These inspections are made from the Washington office, but the regional foresters and their staffs, all of whom are in touch with representatives of public (Federal and State) and private agencies and individuals within each region, make local application of the policies.

There are now 158 national forests. In charge of each, with but few exceptions, is a forest supervisor, directly responsible to 1 of the regional foresters. National forests vary in size, but they average about 1,340,000 acres gross. Each is divided into districts that, varying with topography, work-load, and other conditions, average near 300,000 acres gross. The forest supervisor and his staff and the district ranger and his assistants are in personal touch with local organizations and individuals. With close and intimate knowledge also of national forests, ranger districts, and local situations and problems, these forest officers have the responsibility of protecting and developing each national forest and its resources and administering them in the public interest.

Personnel Management.—Seven percent of the 4,280 permanent employees of the Forest Service are in the Chief's office in Washington. The 93 percent in the field service are supplemented by thousands of seasonal or temporary employees. Methods of personnel management particularly adapted to the far-flung needs and situations of the Forest Service have been developed. During the year some 40 groups, among which were many temporary employees, participated in training camps, conferences, and seminars. In connection with handling large fires, which occur so seldom that men are often faced with grave responsibilities before they have had experience, a motion picture depicting the "one-lick" method of fire-line construction has been developed, as has a series of pictures covering other phases of fire suppression and control.

This year all the regional personnel officers met for the first time in Washington. Much attention was given to employee relations, including the following measures to help insure continuance of united and enthusiastic response: (1) An employee union that gives its representatives an opportunity to be heard on all problems under a form of collective cooperation that is distinct from collective bargaining; (2) a method for testing opinion on any subject so that misunderstandings between employees and employers may be eliminated and cooperation substituted; and (3) strengthening old and creating new "career ladder" opportunities and making them more widely available to women as well as to men.

Cooperative Relationships.—Existing between local people and local forest officers, cooperative relationships help solve local problems within the democratic pattern. These relationships are illustrated by 743 local associations whose members graze domestic livestock on national forests. With officers elected by members, and responsible to them only, these associations are free of any tinge of bureaucracy. Realizing their independence, these associations freely criticize policy and procedure. But criticisms are, on the whole, constructive. From them come suggestions that are invaluable to administrative officers whose responsibility it is to formulate policies and translate them into action; suggestions that help protect public interests as well as interests of the members themselves.

Forests, People, and Democracy

WITHOUT people forests are meaningless. Forestry can hide oppressive human treatment. It can, on the other hand, nurture independent people, and this is a responsibility inherent in the management of all forest lands, no matter who owns them.

We have 630 million acres of forest land in the continental United States. About 90 percent of it is located in some 1,200 counties. One-half are half our farms and some 35,000,000 people. In these counties forest land makes up 60 percent of all land surfaces, and too much of it has been exploited. So have too many people. Aftermaths now include low living standards and undernourishment. Expenditures for public relief are enormous.

Many future citizens will come from these counties. Many people there are underprivileged, but they stem from fine pioneer stock. Their greatest need is for part-time jobs. Rebuilding and improving forest resources there can provide those jobs, but if the people in these forest regions are destined to peasantry for life, democracy will have failed.

THE CIVILIAN CONSERVATION CORPS

The Civilian Conservation Corps, trained to do many jobs, to know why each is worth while, and to know how and where each fits into the pattern of the whole, has made memorable contributions to a permanent and more prosperous civilization. It has built men as well as forests.

The total number of C. C. C. camps varied during the 12 months ended March 31, 1938. On an average, the Forest Service supervised the work of 767 of them. Members of 129 of these camps worked on lands in other than public ownership; those in 216 worked on State-owned forest lands; those in 21 worked on Tennessee Valley Authority

projects; and those in 401 worked on national forests. Major accomplishments are discussed in appropriate places in this report. Statistics may be obtained from the office of the Director of the C. C.

OTHER WORK PROJECTS

Other work projects planned and supervised by the Forest Service during the fiscal year 1938 included (1) the equivalent of 10,755 man-years of employment under the Emergency Relief Appropriation Act with direct Federal allotments by the Works Progress Administration; (2) 225 man-years of employment, National Youth Administration, on projects sponsored by the W. P. A. Accomplishments include, in part, some 1,912 miles of range and other fences, 611 miles of telephone lines, 98 field radio stations, 686 miles of foot, stock, and trap trails, seeding and planting of 71,874 acres of forest land, and more than 40,000 man-days preventing and suppressing forest fires.

FOREST FOLK

National forests are huge work reservoirs. They already support almost a million people, but they also have underprivileged families. This is particularly true on lands purchased from owners who have previously exploited them. This condition creates a heavy obligation that the Forest Service is redeeming as resources at its command permit.

Last year's report described one of these areas. Three-quarters of the people there were tenants, sharecroppers, or squatters. They lived on little patches of land and raised meager home gardens. Ninety-eight percent of all houses had leaky roofs; 95 percent had no screens; only 1 in 10 had a toilet of any kind. Now many roofs are repaired, many steps and porches have been made safe, many windows screened, and many simple but sanitary toilets installed. Average cost, with labor, materials, and supervision included, has been less than \$200 per family. With forest jobs, human as well as forest rehabilitation is under way.

The National Forests

THE primary purpose of national forests is a social one: To assist in building a permanent and a more prosperous civilization by helping (1) safeguard present and future local and national needs for forest services and products and (2) protect watersheds, navigability of streams, and farm, industrial, and other values from damage by erosion, silting, and floods.

Authority to create national forests and add public lands to them was given to the President in 1891. Later restricted, this authority now rests solely in Congress with respect to Oregon, Washington, Idaho, Montana, Colorado, Wyoming, California, Arizona, and New Mexico. Since 1905 national forests and their resources have been protected, developed, and administered by the Forest Service.

Reaffirming the policy of Federal ownership and management of forest lands and resources in the common interest, Congress passed the Weeks law in 1911, and broadened it by the Clarke-McNary law in 1924. This authorizes the Secretary of Agriculture to purchase forested, cut-over, or denuded forest lands subject to (1) prior investigation and report, (2) approval by the National Forest Reservation Commission, (3) prior consent by State legislatures. Such consent has been granted by 38 States and Puerto Rico, usually without limitation but in some cases limited to specific parts of a State or to a maximum area within a State.

AN ACQUISITION PROGRAM

The national program for public acquisition and management of forest lands (p. 27) sets up 59,411,000 acres that, now within existing national forests, purchase units, and areas definitely desirable for purchase, should be added to the national-forest system. This has been carefully examined. Reports on most of it are ready for the National Forest Reservation Commission. The break-down of this acreage by broad regions is as follows:

Northeastern Region.—Some 1,240,000 acres within established national forests, plus 66,000 acres within established or planned purchase units.

Central Region.—About 4,372,000 acres within approved purchase units, plus 3,558,000 acres that, examined and reported upon, should help solve problems of flood and erosion control and economic readjustment.

Lakes States Region.—There is urgent need for rebuilding forest lands here, and for maintaining their productivity. There is a relatively large acreage in State, county, and municipal forests. There should be more. But there are 5,048,000 acres of privately owned land within existing national forests and purchase units and another 35,000 acres near them that should be federally acquired.

Plains Region.—Some 438,000 acres within existing national forests, and 706,000 acres now outside established units.

Southern Rocky Mountain Region.—Within established national forests, 3,110,000 acres, and outside them, some 662,000 acres.

Region of the Columbia River Basin.—To simplify administration and promote unity of management, approximately 7,731,000 acres

within established national forests should be federally acquired. Should 1,363,000 acres adjacent to existing national forests.

California Region.—The program involves the purchase of 4,221,000 acres within national forests in this region.

The South.—There are 13,701,000 acres of privately owned forest lands that, within approved national forests or purchase units, should be made integral parts of them. And although a progressive minority of private owners has made real progress in forest management, detailed examinations indicate some 13,160,000 acres more that, in the public interest, should be added to the national-forest system.

CURRENT PROGRESS IN ACQUISITION

Forest land in private ownership may be acquired for addition to national forests through exchange, purchase, donation, and transfer. Forest and watershed public domain may be added through boundary adjustments. A summary of the progress made during the fiscal year follows.

Exchange.—Under acts of Congress, privately owned forest land may be acquired through exchanges of not more than equal values of national-forest land or stumpage in the same State.

Exchanges with Michigan contributed to effective and economic management of State and national forests. Under one exchange previously approved, the State conveyed 23,357 acres and received 20,085. Through six more not yet approved, Michigan will convey 133,034 acres, valued at \$403,396, and receive 70,621 acres, valued at \$403,389.

In all, 84 exchanges were consummated during the year. The United States acquired 242,679 acres valued at \$1,447,206; granted 28,959 acres valued at \$73,343 plus 581,899,000 board feet of national forest stumpage valued at \$1,124,119. Net gain in national-forest area was 213,720 acres. In addition the Secretary approved and referred 151 exchange cases to the Secretary of the Interior. They involve 200,575 acres of private land valued at \$823,834, 14,284 acres of national-forest land valued at \$60,832, and national-forest stumpage valued at \$600,459.

Exclusive of certain early cases, the total number of exchanges completed to June 30, 1938, was 1,370. The United States acquired 2,242,288 acres, valued at \$8,605,451; it gave in exchange 539,704 acres valued at \$2,253,377, and 2,113,648,000 board feet of stumpage valued at \$5,021,644. Unit values of stumpage thus acquired have increased, and better protection and management have been obtained at lower costs. The net gain in national-forest area brought about by all the exchanges completed by June 30, 1938, was 1,702,583 acres.

Purchase.—The National Forest Reservation Commission held five meetings during the year and approved for purchase a total of 800,113

acres at a cost of \$2,712,762. During the year 1,433,078 acres were vested in Federal ownership. The area purchased now totals 15,672,12 acres. With 2,710,125 acres reserved from the public domain, transferred from other Government agencies, or acquired by donation, and 267,336 acres acquired through exchanges, Federal holdings acquired through the Weeks and Clarke-McNary laws now amount to 18,650,073 acres. An additional 1,068,299 acres is in course of purchase. Details are given in the annual reports of the National Forest Reservation Commission.

The Bates College Experimental Forest, in Maine, has been renamed the Massabesic Experimental Forest, and a moderate expansion has been authorized. Purchase in the Uinta and Wasatch National Forests, for which special provision was made, has been extended. Purchases under Weeks law as amended are ordinarily restricted to established purchase units. Establishing additional units or enlarging existing ones is not favored by the National Forest Reservation Commission until funds more nearly meet requirements than is the case with annual appropriations of only \$2,500,000 to \$3,000,000.

Donation.—During the year, 44 tracts embracing 2,847 acres were donated and accepted by the Secretary for national-forest purposes. The total donated, to June 30, 1938, including administrative sites, was 297,639 acres.

Transfer.—To adjust land occupancy and use, the Resettlement Administration and its successors have purchased submarginal land. Some of it, chiefly valuable for forest purposes, has been transferred to the Forest Service. Transfers made by the President during the fiscal year include 368,678 acres from the Wakulla, northeast Georgia, Piedmont Georgia, west Alabama, Drummond, Crandon, Ausable, and Lakewood projects to the Apalachicola, Chattahoochee, Talladega, Chequamegon, Huron, and Nicolet National Forests.

The Secretary of Agriculture, under Executive Order 7530 of December 31, 1936, as amended, and title III of the Bankhead-Jones Farm Tenant Act, assigned to the Forest Service for administration six land-reclamation projects originated by the former Resettlement Administration in Washington, Oregon, New Mexico, Colorado, and Missouri. They have an aggregate gross area of 1,030,066 acres, of which 469,601 are owned or in course of acquisition by the United States. Presidential authority to create or add to national forests still applies in Missouri, but national-forest status for units in Washington, Oregon, New Mexico, and Colorado must come through Congressional action.

Boundary Adjustments.—Inclusion within national forests of such public-domain forest and watershed lands as are geographically and economically integral parts of national forests, will assure protection and management at lower costs, reduce the number of Federal agencies with which the public must deal, and help solve control problems of land use and management.

This inspired most of the 58 bills introduced in Congress during the fiscal year to adjust national-forest boundaries. Action on many was deferred largely because of differences in viewpoints and philosophies. Congress did, however, enact bills adding to the Kaniksu, Black Hills, Rio Grande, Trinity, Ochoco, Columbia, and Snoqualmie National Forests a gross area of 272,111 acres (96,191 acres net), and extended provisions of the general-exchange act to related private lands. Three other bills extended provisions of the general exchange act to 857,090 acres adjoining the Klamath, Lassen, Modoc, Plumas, Shasta, and Tahoe National Forests, Calif., and authorized the President to add 47,799 acres owned there by the United States.

The act creating the Olympic National Park reduced the Olympic National Forest by 648,000 acres. Another act transferred 38 acres from the Tongass National Forest to the University of Alaska for an experimental fur farm; and 6,408 acres were eliminated from the Coronado National Forest and added to the Chiricahua National Monument.

ABSTRACTING

Abstracting and land title records are parts of acquisition. In regions 7, 8, and 9, 1,868 cases, involving 596,958 acres, were accepted for acquisition. Approximately 88 percent of the abstracting work on these cases has been accomplished, and in 21 percent of the cases title has been vested in the United States. Fewer cases are being submitted for condemnation, and improvement has been noted in the dispatch with which all cases are handled.

NATIONAL-FOREST PROPERTIES

As of June 30, 1938, the national-forest system (p. 26) included 15 national forests, plus 37 established purchase units formally approved by the National Forest Reservation Commission. Additions to national forests during the year were offset by three eliminations that (unreconciled by pending surveys) involved 652,146 acres net. With basic statistical material heretofore included in the annual report, tabular compilations of the year's additions to and eliminations from national forests are now included in Section Z, Administrative Statistics. Requests (p. 55) for this section should be addressed to the Forest Service, Washington, D. C.

Within a gross area of 227,280,025 acres in national forests and purchase units are 175,238,168 acres of national-forest lands. In addition, jurisdiction over 1,030,066 acres gross (within which the Department of Agriculture has taken steps to acquire 469,601 acres) has been assigned to the Forest Service for administration and protection. Not counting certain areas awaiting title clearance before final payment can be made, included in each of the above net-area figures, the total

net area now under jurisdiction of the Forest Service is 175,707,769 acres.

Protecting the National Forests

Most national-forest resources and values are subject to damage and destruction by fire. Many fires are set by lightning, but altogether too many are man-caused. Timber on national forests is subject to attacks by forest insects and diseases. When epidemic proportions are reached they often cause enormous damage.

PROTECTION FROM FIRE

Lightning set 5,470 fires in or adjoining national forests during the calendar year 1937, and 6,195 were man-caused. More than 72,200 national-forest acres were burned over. The damage is estimated at \$151,380.

Human ingenuity has not yet devised any way to prevent lightning from starting forest fires, but most man-caused ones are due to carelessness and neglect. Since it should be possible to eliminate them, prevention is the first step in forest-fire protection.

Fire Prevention.—Fire prevention is carried on by planned educational campaigns in cooperation with newspapers, radio stations, motion-picture theaters, and civic and other organizations. It involves exhibits, lectures, pamphlets, literature, and admonitory signs. In part for their own protection, visitors to many national forests may be registered during the fire season, and may be required to equip themselves with simple fire-fighting tools. During dangerous periods and in dangerous localities campers may use fireproofed campgrounds only, and smoke only at places of abode and others specifically designated. It is sometimes necessary to regulate or prohibit travel for short periods in certain areas. Every effort is made to apprehend and prosecute persons responsible for starting forest fires.

In these activities the C. C. C. helps. It also reduces fire hazards by removing inflammable material along roads and trails, and constructing and maintaining roads, trails, telephone lines, and lookout towers (p. 17) essential to protecting national forests from fire.

Fire Suppression.—The 1937 fire season was disastrous from the standpoint of loss of life, but losses of area by fire have never before been held to so low a total. The average for all regions was only 600 acres burned per 1,000,000 acres protected.

In this many factors played a part. One was increased appropriations. Another was research, including developments that, for example, make possible quick and reliable measurements of fire

danger and increased efficiency at lower costs for detection, communication, and transportation. A third was the advance in the science of fire control. Cumulative efforts to secure better public understanding and support helped to reduce the number of man-caused fires to 53 percent of those in 1936. The fire suppression work done by the C. C. C. was invaluable, and 15 heroic C. C. C. boys lost their lives. But a share of the credit for the 1937 fire record must in all fairness be ascribed to relatively favorable fire weather.

Special measures to guard against surprise fires and strengthen the fire-control structure were mentioned in last year's report. Among them was a light motor-driven power tool for clearing fire lines. Tests indicate that this machine may prove of major importance. Certain radio equipment designed by the Forest Service has become a commonplace feature of fire detection and suppression. The number of sets on national forests is now about 2,500. A two-way radio phone unit for trucks and other vehicles is in production, and Congress has provided the impetus that may make the autogiro a large factor in forest-fire suppression.

As the honor roll discloses, 15 men met horrible deaths in the Blackwater fire or died afterwards from injuries received there. Thirty-eight others were injured but recovered. Exhaustive analyses started before this fire was out, disclose that the tragedy was due to an unforeseeable combination of sudden changes of weather plus the fact that timber immediately above the fire line had not "crowned out" when its ground fuels burned. As a result the burned space above the fire line, which should have been a refuge when wind-driven spot fires swept up from below, actually reburned. This deprived crews of what should normally have been a nearby safety zone. Experienced forest officers and foremen are always on the lookout for such deadly combinations of adverse circumstances. Occasionally, however, no degree of vigilance or judgment is sufficient to guard against risks that are part and parcel of forest-fire suppression.

The Honor Roll.—The 1937 honor roll of men who died on far-flung national-forest fire lines or from injuries received on them is a heavy one. It includes 20 men: Alfred G. Clayton, Paul E. Tyrrell, James T. Saban, Rex A. Hale, Clyde Allen, Roy Bevans, Ambrocio Garza, John B. Gerdes, Will C. Griffith, Mack T. Mayabb, George I. Rodgers, Earnest R. Seelke, Rubin D. Sherry, William H. Whitlock, Billy V. Lea, Andrew D. Lindgren, Fred Dunlap, Albert A. Boma, G. F. Carmichael, and Lloyd G. Hornby.

The 15 men listed first met death in or as a result of the Blackwater fire on the Shoshone National Forest; the last 5, in the order listed, from fires on the Huron, Nicolet, Shasta, Roosevelt, and Clearwater National Forests, respectively.

PROTECTION FROM INSECTS AND DISEASES

Damage to national-forest timber by several different species of bark beetles and other destructive forest insects continues. Control measures were necessary during the year to protect red spruce on the Green Mountain National Forest, in Vermont, from an infestation of spruce bark beetle. Bark beetle attacks in ponderosa pine in Colorado and in lodgepole pine in Colorado and Wyoming made sizeable control measures necessary. Smaller projects had to be initiated in other western national forests.

The national-forest area treated during the year because of insect attacks totaled 421,000 acres. Treatment was applied to 55,485 trees. Surveys and scouting to detect and locate incipient outbreaks, so control might be applied early, were continued. Close cooperation was maintained with the Bureau of Entomology and Plant Quarantine. Control of white-pine blister rust in commercially important white-pine-producing areas in the East has progressed. The situation is serious, however, and the hazard is still great in western white pine within the "Inland Empire" and in sugar pine within parts of Oregon and California. The disease here is particularly virulent, and young reproduction of both western white and sugar pines is highly susceptible.

Treatment has extended to 2,152,700 acres of national-forest lands, but an estimated 1,775,300 acres of five-needled pine-producing land have not been given even an initial treatment. Of this, about 1,000,000 acres are in the sugar-pine region of California and Oregon, and about 500,000 acres lie in the western white-pine region of northern Idaho, western Montana, and eastern Washington.

During the year initial treatment was given to 56,800 acres, and in 28,900 acres repeat treatments were made. Of the total, 30,500 acres were treated by the C. C. C. Expanded control programs are essential if the spread of the disease is to be checked and pinelands kept productive. Serious losses in future timber production can be averted only by concentrated work during the next 2 years.

Administration and Development

NATIONAL forests, purchase units, and certain other areas (p. 36) now in Federal ownership constitute an area larger than Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Delaware, Pennsylvania, Ohio, Indiana, and half of Illinois. Part of the responsibility of the Forest Service (p. 28) is to administer and develop these public properties within which land and water are basic to such other resources and

assets as timber, forage, wildlife, and recreation, and the many services they render to individuals, communities, States, and the Nation.

LAND

In this no clear-cut distinction can be drawn between land itself and other resources, assets, and services essential to a permanent and prosperous civilization. There are, however, certain processes that so directly concern land that it seems logical to report upon them here.

Surveys and Maps.—Accurate maps are essential for adequate and efficient protection, development, and administration of land and resources. Maps have already been prepared for most national forests and purchase units, but much of the data originally available was inaccurate. For certain other areas practically no map data have been available; so additional surveys are necessary. In making them the aerial-photographic method is generally used. Pictures thus secured are also invaluable in fire control, for range surveys, and for determining distribution and density of timber stands. Forest Service mapping conforms to standards of the Federal Board of Surveys and Maps. Aerial photographs during the year covered 20,550 square miles. Topographic and drainage surveys by ground methods covered 2,930 square miles.

Highways, Roads, Trails, and Landing Fields.—Forest highways, primarily for public travel between cities and towns, are essential parts of national and State highway systems. Development roads or truck trails supplement local road systems and permit the transportation of forest products, minerals, etc., to railroads, main highways, and communities; provide ingress and egress for domestic livestock and for hunters, campers, fishermen, and others. Horse and foot trails extend the transportation system into "back country" within which—since fire danger requires rapid transportation of men, supplies, and equipment—trails are supplemented, where possible and necessary, by airplane landing fields.

Planning correlates and coordinates the entire transportation system and relates it to local needs. Funds for the construction and maintenance of forest roads and trails during the fiscal year include: (1) The 10-percent fund, which totaled \$485,818.80; (2) appropriations under the forest road and trail item of the Agriculture appropriation bill (and in accordance with section 23 of the Federal Highway Act of November 9, 1921), which totaled \$12,500,000 (\$8,150,000 for forest highways and \$4,350,000 for the development roads or truck trails); (3) cooperative funds, provided mostly by the States, totaling \$742,192.

Expenditures and contributed time of agencies other than the Forest Service, evaluated at \$5,952,863, were also used. Most of these con-

contributions were by the C. C. C., which constructed 1,436 miles of truck trails, and 342 miles of horse and foot trails on national forests and maintained 26,767 miles of the former and 12,117 of the latter.

The planned national-forest transportation system includes 24,175 miles of forest highways, 113,396 miles of forest development roads, 52,840 miles of horse and foot trails, and a number of airplane landing fields not yet determined. Of the highway and road mileage, some 46 percent has been completed to satisfactory standards. Approximately 78 percent of the trail system is also completed. To December 31, 1937, 66 landing fields had been used. Estimates indicate the need for some \$417,000,000 to complete construction and betterment work on national-forest highways, roads, and trails. Of this about \$291,800,000 is for forest highways, \$120,800,000 for development roads, and \$4,400,000 for trails. Details by States are included in Administrative Statistics, mentioned on page 55.

Settlements, Claims, Special Uses.—Final application for patents or homesteads in national forests totaled 112 during the year. On these, 96 favorable reports were made and 16 unfavorable ones. Final application for mineral patents to lands in national forests totaled 77 during the year. On them, the Forest Service made 56 favorable reports and 21 unfavorable ones.

Active special-use permits for small areas of national-forest lands totaled 40,722 last year. This fiscal year the number was 41,293. Rental charge was made on 22,112 of last year's permits and on 22,348 in this year's. The remainder were, in both years, issued without charge. Special-use receipts for the fiscal year totaled \$366,267.62.

Northern Pacific Land-Grant Suit.—The Northern Pacific land-grant suit involves the claim of the company for damages because it was denied the right to select 2,800,000 acres of land within its indemnity limits in Wyoming, Montana, Idaho, and Washington. In March 1938 the report of the special master, appointed to adjudicate the company's equities, was reviewed by the United States District Court at Spokane, Wash. Decision of the lower court was adverse to three company claims and to two contentions of the United States. Under the act of May 22, 1936, either party to the suit may appeal directly to the United States Supreme Court on legal points. Appeal is anticipated. If the Supreme Court sustains company claims the next step will be to determine the value of the lands in which the company is found to have equitable interest. Prospects of a final decision at an early date are remote.

WATER

One major purpose of national forests is to secure favorable conditions of water flow. This has been and is an important consideration in the acquisition program (p. 33) and in protecting, developing, and administering national forests generally.

Uses of Water.—Almost every major stream west of the Great Plains heads in some national forest. So do most minor ones. Water from their protected slopes is indispensable for:

(1) Domestic purposes. Nearly 400 cities and towns (including Portland, Oreg., Los Angeles, Calif., Salt Lake City, Utah, Prescott, Ariz., and Denver, Colo.), get domestic water from national forests. They have water investments totaling close to half a billion dollars.

(2) Irrigation. The 1930 census shows within 11 Western States some 932 million dollars invested in irrigation enterprises. Almost 90 percent is based on water from national forests.

(3) Power. More than 11 million potential horsepower is from water that originates in national forests. That developed and applied for which it is estimated, involve an investment close to 1¼ billions of dollars.

Much national-forest water power is used by industries miles from the source, but there are many opportunities for developing more local industries using more local power. Possibilities for pulp and paper manufacture and electrochemical processes in southeastern Alaska offer an outstanding example. It is estimated that 250,000 horsepower is available in or near pulpwood forests capable of sustained output of 1 million tons of newsprint each year.

In cooperation with the Federal Power Commission, the Forest Service handled 42 applications for water-power permits or licenses involving the use of national-forest lands during the year. This was 74 percent of the current number received by the Commission. At the end of the year the Forest Service was administering 444 permits and licenses for the Commission and had made monthly reports on 88 projects.

There are still in effect 182 active permits and easements issued by the Forest Service prior to the passage of the Federal Water Power Act. Of these, 98 are for power-generation projects with combined estimated average low-flow output of 335,401 horsepower and combined estimated installed capacity of 685,255 horsepower, and 84 are for transmission-line projects with a length of 744.4 miles within national-forest boundaries. During the year annual rental fees were charged on 54 power projects (estimated low-flow output, 317,099 horsepower) and 70 transmission-line projects (length, 641.2 miles). No rental fees were required on 44 power projects (estimated low-flow output, 18,309 horsepower) or on 14 transmission-line projects (length, 103.2 miles).

Shortly after the end of the fiscal year the Attorney General held that authority to issue licenses or permits for operation of electric power-distribution lines in national forests rests with the Federal Power Commission.

Flood Control.—To most people flood control means strong levees, deep channels, and huge reservoirs. It is difficult to apply a yardstick to the services they perform, but we know we need these mar-

ade structures to help confine angry waters, prevent widespread human misery and property damage, and save lives.

National forests also render services with respect to floods. Their forest soils absorb moisture readily, hold a great deal of it in hills and mountains, then release it gradually so flood crests may more easily be kept within the bounds of man's mighty downstream engineering works.

That is why as a Nation we are turning from rivers to rivulets, from ramparts to sources from which floods come. We still recognize the value of major engineering works. They must be continued and expanded. But we must also have such common-sense measures as foresting and regrassing of land unfit for cultivation; protection of existing forest and grassland cover, and controlled use of them. For these things, based on research and applied to watersheds where floods have their origin, help save soil for productive use; help eliminate recurring minor floods; help reduce the velocity of surface run-off that contributes to major floods; help reduce damage to farms and industries in the lowlands and the silting of reservoirs and navigable streams.

Cooperating with the Flood Control Coordinating Committee of the Department of Agriculture, which in turn cooperates with the War Department, the Forest Service is actively engaged in examining watersheds. And within national forests, largely through the assistance of the C. C. C., the Forest Service is applying positive measures that help control soil erosion and the too-rapid run-off of water.

TIMBER

Timber, like other national-forest resources, is developed and administered so it may afford maximum opportunities for employment and contribute continuously and as fully as possible to stable community life.

For years selective logging has been a standard national-forest practice in certain forest types. One exception has been in the Douglas-fir type. Here in the past clear cutting was usual on national forests and land in private ownership, but within the last decade powerful trucks and tractors have made selective logging physically possible. A few years ago the information accumulated by research and administration indicated that, from the standpoint of economics as well as from that of silviculture, it was possible to apply within the Douglas-fir type a selection system modified to fit that type. That modified system is now adopted, as conditions and circumstances make it possible, in Douglas fir on the national forests. It is being tried out also on certain private holdings.

To help nature increase growth and value of timber stands, most forests need cultural operations. Much of this has been done by the

C. C. C., but there are millions of acres that still need it. The need, for example, for harvesting timber from relatively small areas or the need on which the stand is relatively light, and for harvesting low-grade material, indicates the desirability of authorizing the Forest Service to conduct logging operations and offer unprocessed forest products for sale on the basis of roadside delivery. Such authorization would permit harvesting certain forest stands unattractive to private industry and would provide employment for local people in need of jobs. Authorization should, however, be used sparingly and only if after roadside delivery the products can be sold for not less than cost plus a reasonable stumpage allowance.

As is indicated on page 19, there is also need for legislative action that will make unity of management practicable for forest lands that are in adjacent or intermingled private and public ownership, lie in natural topographic and economic units.

For years research has enabled foresters to write for most major types the few simple rules that, properly applied, will keep forest lands productive. More than this preliminary step is necessary, however, before forests can be continuously harvested so as to bring security and stability to dependent families and communities. For a few types the more detailed information necessary to intensive forest practices is becoming available. In the western white pine type in the northern Rocky Mountain region, for example, we now know that it is silviculturally feasible to apply three methods of harvest—clear cutting, scattering seed tree, or shelterwood—provided economic conditions permit and each method is employed under the proper site conditions. Another example of progress in research concerns Lakeland States jack pine. This species has been hard to regenerate after logging. It now appears that mechanical scarifications of soil prior to clear cutting or heavy cutting, plus the scattering of cone-bearing branches over the area after such cutting, seems necessary if adequate regeneration of the species is to be obtained.

Research in tree breeding carried on by the Forest Service to secure superior strains for planting or for natural reproduction shows promise. Within the last year or so similar programs have been started at Harvard University, by the Dominion Forest Service in Canada, and by at least one private organization interested in wood products.

Sustained Yield.—Plans were prepared during the year for a number of working circles. Wherever such circles are adjacent to private holdings the policy is to sell national-forest timber only at such times and in such a way as to help convert private operations to a sustained yield basis. In a number of cases, however, quantities in working circles are relatively small, and sales of mature timber and advanced second growth may be made to established mills provided operations (1) contribute to welfare of local families and communities, and (2) increase the quality and rate of growth of the remaining stand.

The Sublimity circle on the Cumberland National Forest, Ky., was one of those established last year. It provides an annual cut of 5 million board feet on a sustained-yield basis. In accordance with his contract the purchaser gets part of his labor from residents on the Sublimity Resettlement Project.

Developments in the Prineville working circle, Ochoco National Forest, Oreg., include the acquisition by the Federal Government of 9,925 acres of virgin ponderosa pine. A cooperative agreement calling for unity of management with respect to certain private holdings of national-forest timber is an essential feature of the purchase. After being cut under approved standards, company lands will be offered to the Government in exchange for national-forest timber. In return for this concession the Forest Service agrees to make available national-forest timber that will round out an operation the average annual cut of which shall not exceed the sustained-yield capacity of the working circle.

Timber Sold and Harvested.—Most national-forest timber sales are small. Each operator pays for stumpage in advance of cutting but does not have to pay in advance for the total amount covered by his contract. This makes timber available to individuals and small local concerns who may not have much working capital.

During the fiscal year 21,916 national-forest timber sales were made. Of these, 20,440 amounted to \$500 or less. The stumpage involved in all sales was equivalent to 1,074,916,000 feet, board measure; that involved in sales and exchanges was equivalent to 1,094,599,000 feet, board measure. Timber cut under sales and land exchanges totaled 287,917,000 feet, board measure, with receipts of \$3,066,694. The national-forest timber-sale business is shown by States in Section Z, Administrative Statistics. Dead and down national-forest timber is customarily granted free to local settlers for personal use.

Planting.—More than 4,500,000 acres in national forests must be planted before they can produce crops of merchantable timber. Much of this land is in localities where there is urgent need for employment. In planting would, it is estimated, provide more than 13 million man-years of labor and make this 4½ million acres productive again. Yet the present appropriation for national-forest planting is only \$400,000 a year. This is inadequate to accomplish the job within any reasonable time, even though full advantage is being taken of C. C. C. and other emergency labor and funds.

The Forest Service operates 26 national-forest nurseries. From them, during the calendar year 1937, 147,166,000 trees were distributed. Of these, 136,809,000 were used for national-forest planting; 10,357,000 were supplied to other Federal agencies, and to States for distribution under the Clarke-McNary law. National-forest field planting during 1937 totaled only 155,744 acres. In 1936 it was

214,306 acres. Direct seeding amounted to 683 acres in 1937. In 1936 it was 8,769 acres.

Cumulative results through research in seeding, planting, and nursery work are invaluable. Current studies indicate, for example, that specific gravity is a reliable index of the time when seeds are ready and cones ready to open. This, and improved methods of extracting longleaf pine seed in kilns, should make it possible to avoid waste. Nursery and planting techniques, demonstrating that survival may be increased as much as 50 percent in severe seasons by proper choice of stock for field planting, should make it possible to reduce planting costs.

To date the Forest Service has planted 897,642 acres on national forests. Of this acreage, some 75 percent shows promise of bearing satisfactory stands of timber. Despite every care to get the right species and age classes of planting stock grown from satisfactory seed sources, and to use the best-known field planting practices, replanting due in large part to deterioration caused by fire and erosion—has been or is necessary on 25 percent of this area.

Besides initiating timber production, planting improves watersheds and helps prevent erosion, contributes to recreational values, and is coordinated and correlated with wildlife management. Current annual output of national-forest nurseries, and total national-forest acres planted and sown by States, are included in Section Z, Administrative Statistics.

FORAGE

Forage—in the form of grass, weeds, and browse—is a major national-forest resource; it supports wildlife, in itself a resource, and domestic livestock. Like timber, forage is renewable. On national forests it is cropped on a sustained-yield basis and so managed as to obtain maximum benefits for dependent families and communities. This requires correlation of use with use of forage on adjacent lands. Since use of national-forest forage by wildlife is summarized on pages 49 and 50, the following discussion is confined to forage in relation to use by domestic livestock.

Early Administration.—When the first national forests were created in most Western States were only partially settled; conditions favored large livestock operations. When in 1905 administration was transferred to the Department of Agriculture, most national-forest ranges were already occupied by cattle and sheep. Many early grazing permits, recognizing prior use, were therefore for relatively large numbers of stock.

Between 1905 and 1914 the West was settled rapidly. Many ranges outside national forests were fenced. Partial or total liquidation of many large outfits ensued. Needs for national-forest range by settlers and other new applicants were not difficult to satisfy during the

period. Increases during the World War totaled 180,000 cattle and 70,000 sheep, but wartime pressure forced too heavy stocking of many ranges. This required protection reductions, but it was impossible to allot much range to new permittees.

In 1925 came more fencing of outside ranges acquired under the Grazing Homestead Act, with heavy demands from new applicants. National-forest term permits were instituted. When the term-permit period ended, in 1934, the needs of new applicants were acute. Reductions in established permits were made. They affected 1,100 cattle permittees and 500 sheep permittees, and a total of 15,500 cattle and 100,000 sheep. But the range gained met only a small part of the needs of new applicants and small users. Extended droughts, decrease in forage production, and further range-protection reductions, indicated the need for thorough study of the whole situation.

Distribution Survey and Policy.—The distribution survey, summarized in last year's report, is completed. Its findings and conclusions have been discussed with livestock and related groups. Criticisms were frank, suggestions helpful. Policy, being analyzed and discussed, places emphasis on such range management as will contribute the maximum to restoration and perpetuation of forage values in national-forest ranges and related lands. Stability is provided for. The size of future permits is governed by three classes of limits, to be determined locally. Present term-permit contracts will continue until the close of their period. The new policy will not operate to the detriment of present term-permit holders. New grazing regulations will be issued this fall.

Market Conditions and Fees.—Despite a late decline in prices, market conditions averaged better than for 1936. Grazing fees for 1938, based on 1937 market prices, were increased an average of 2.43 cents per head per month for cattle; 0.58 cent for sheep.

Permits and Numbers of Stock.—In the calendar year 1937 there were grazed under 19,497 pay permits 1,254,425 cattle, 29,499 horses, and 241 swine; under 5,652 sheep permits, 5,477,351 sheep and 7,603 goats. Cattle permittees decreased 3 percent from 1936, sheep permittees 3 percent; the number of cattle grazed under pay permits increased 2 percent, sheep 3 percent. In addition, 29,833 cattle, 821 horses, 11,067 sheep, and 1,039 goats were permitted under regulation authorizing free grazing of not to exceed 10 head of stock by any one person. During 1937, 53 percent of the cattle and 58 percent of the sheep in the national forests of the 6 western regions were grazed under term permits that began in 1936.

Reductions, Trespass, Losses.—Reductions in 1937 for range protection totaled 10,749 cattle and horses and 38,009 sheep and goats. Reductions for distribution totaled 551 cattle and horses and 3,404 sheep and goats. There were 20,682 cattle, 33,414 sheep, and 3,621 wild horses in trespass for varying periods in 1937. Livestock losses totaled

16,111 cattle and 161,770 sheep. Poisonous plants and predators were major causes of these losses.

Rodent Control.—To help save forage, rodent control, principal under cooperative direction by the Bureau of Biological Survey covered 749,162 acres. The national-forest area treated to date 13,845,761 acres; areas still infested total 13,529,188 acres.

Range Surveys.—During the calendar year 1937 some 5,852,000 national-forest acres were covered by intensive range surveys. The net total to date is 52,943,818 acres, plus 21,086,403 acres covered by less intensive surveys. Public agencies other than the Forest Service also make range surveys. Of the 728 million acres in all western ranges nearly one-fourth had been covered by 1937. In that year a cooperative project between the several agencies was initiated for coordinating survey methods and jointly assembling and interpreting the data. During the year data for nearly 55 million acres were assembled on uniform maps, and plans were prepared to maintain range productivity and improve management.

Local Livestock Associations.—Those cooperating with the Forest Service during the year numbered 743. Of these, 719 had qualified for recognition under advisory board regulations. Field officers report that only 73 more local associations are needed to cover all national-forest grazing allotments.

Range Research.—Range research has added immeasurably to the methods for improving range-forage conditions. Increased grazing capacity obtained on demonstration areas has stimulated reseeding by ranchers and stockmen. Experiments indicate reasonable success may be expected at moderate costs when: (1) Areas having average or better soil and moisture conditions are chosen; (2) seed of species already proven successful is sown; (3) seed is so sown as to be covered with soil; and (4) grazing is adequately controlled. The sagebrush bunch grass zone can probably best provide forage when grazed on a rotation system that assures vigorous green feed during spring lambing period, and adequate fall feed during the breeding season. Experiments in southern Arizona show that good range management pays. A cooperating stockman on the Santa Rita Experiment Range made 8 percent on his investment during an 11-year period by applying sound range-management principles that brought greater earnings than rule-of-thumb management.

Range Management.—Range management has always occupied a prominent place in the work of the Forest Service. It is fair to say that, despite such things as overstocking during the war, and protracted droughts, most national-forest ranges are in better condition than others of comparable size. There is, however, real need for improvement; a need it has not seemed possible to meet because of ever-increasing demands upon fieldmen for planning and supervising such things as work-relief programs, increased use of timber, needs for

recreational facilities, and solution of wildlife problems. Demands like these have resulted in less range management on the ground. Efforts will be continued to carefully plan the time of forest officers, but the present administrative force cannot properly carry the increasing work load. Additional funds are needed.

WILDLIFE

Hunting and fishing have always been part and parcel of life in North America. Game populations receded alarmingly with settlement and reached an all-time low about the beginning of the present century. Nearly 75 percent of the big game in Western States now depends on national-forest forage in summer. Wildlife in all national forests includes about 1,700,000 big-game animals; some 1,800,000 fur bearers; game birds like the grouse and turkey; fish in about 70,000 miles of streams and in hundreds of thousands of lakes and ponds. From inspirational and practical viewpoints wildlife is a precious national forest resource.

Basic Conditions.—While on national forests, big game depend for food on the forage there. So do many domestic livestock. This has led to misunderstandings. These, in turn, have provoked expressions of opinion by some sincere wildlife enthusiasts to the effect that all domestic stock should be excluded from all national forests. Yet on the whole this opinion is not justified, for basic facts and conditions indicate that:

1. Except for stock such as is used by tourists, only about 60 percent of all federally owned national-forest land in the continental United States is used by domestic livestock. In round numbers this includes 91,000,000 acres.
2. With the exception noted 40 percent, or about 62,000,000 acres, is, insofar as it is adaptable, for exclusive use by big game.
3. Big game also use much of the 91,000,000 acres grazed by domestic livestock. This is partly because of the marked differences in food habits of domestic animals and certain species of big game; in part because of regulated stocking and conservative use of national-forest ranges by domestic livestock.
4. Despite a decrease of wildlife generally, the use of national-forest ranges by domestic livestock, and open hunting seasons, big-game populations on the national-forest system have increased about 150 percent since 1924.

5. With more winter range, wider distribution, and better management, there is room on most national forests for a much larger big-game population than now exists there.

Basic Problems.—Big-game summer ranges in most western national forests greatly overbalance winter ranges. Indeed, in most cases winter range is so scarce that it, more than any other one factor,

limits local populations of big-game species like deer and elk. Since in the West most winter range suitable for big game is now in private ownership, the solution of this problem appears to depend in large measure on greater dedication of private lands to wildlife, or land acquisition by public agencies to improve wildlife conditions.

Current problems of distribution center to a large extent around overpopulations of big game, and concentration on early-spring, late fall, and winter ranges during seasonal migrations. About 20 problem areas of this sort have developed within national forests recently. The most conspicuous concern deer on the Kaibab National Forest in northern Arizona; elk on the Gallatin and Lewis and Clark National Forests, in Montana; deer and elk on the Gunnison game refuge, Colorado; deer on the Murderer's Creek drainage, in Oregon; and elk on parts of the Sitgreaves National Forest, in Arizona. Some of these problem areas have developed out of natural increases in stock transplanted years ago, and the situation has been aggravated because State laws have not permitted adequate management in time to avert present conditions. These problems can be solved by wildlife management.

Wildlife Management.—Good business dictates that forage in national forests be so maintained and used that wildlife and domestic stock may both contribute in the highest measure to the social and economic welfare of families, communities, and States. Ordinary business prudence dictates that no herd of domestic stock shall be permitted to increase beyond the supply of feed available to carry it, and that man should make orderly herd reductions rather than permit indeterminate and indiscriminate losses by starvation, for example. The same principle applies to big game. It can no longer shift for itself; it must now have human help and guidance. In this, control of numbers is essential and far more humane than vicarious control by starvation.

Cooperation.—Increases in the big-game population on the national forests have in large measure been made possible by friendly cooperation. In this, sportsmen's clubs and other public and private agencies have helped, but State game departments, commissioners, and game laws and regulations afford the most effective media for cooperative wildlife management. Cooperative agreements with States have not been perfected or are in process of negotiation in all States within which there are appreciable national-forest areas. To accomplish this, enabling legislation has been necessary in many cases. In certain Eastern States, where lands in Federal and private ownership are intermingled, many recent agreements are, in effect, management programs and action plans.

The C. C. C. has helped protect and develop national-forest wildlife resources. It has surveyed, mapped, posted, and sometimes fenced game refuges; made game counts and surveys; studied game habits

and food plants; planted food shrubs; built fish hatcheries and rearing ponds; planted fish fry; done stream-improvement work.

RECREATION

Stresses of modern life have increased manyfold over what they were. Human beings need escape now and then to a more primitive world geared to a slower speed. They need recreation, which is no longer a luxury—recreation in the form of that peace, beauty, and adventure that forests are peculiarly fitted to supply.

National forests help supply recreational and inspirational values that in themselves help underwrite a better and a more permanent civilization. During 1938 more than 30 million visits to national forests were made by sightseers, campers, picnickers, resort and summer-home visitors, hunters, fishermen, hikers, horseback riders, mountain climbers, winter-sports enthusiasts, and others. Excluding sightseers and those simply passing through, approximately 14½ million of these visits were by people who stopped on the national forests for recreation. Each of these visits does not represent a separate person, for many people came frequently. It is, however, fair to say that millions of different people benefited from national-forest recreation; and millions more, merely driving around, enjoyed the cool freshness of mountain air and the beauty of the scenery.

Public Campgrounds.—Many national-forest visitors stop at hotels, summer resorts, and dude ranches. Others go to summer homes built under (p. 41) special-use permits. People with inclination and time pierce one or more of the 30 national-forest primitive areas that embrace about 17 million acres. But most national-forest visitors head for free campgrounds equipped with fireplaces, pure water, and simple but sanitary conveniences. There are now more than 3,500 of these developed campgrounds in the national-forest system. Most of them, and literally thousands of others not yet developed, may be reached by automobile. The C. C. C. has been a big factor in developing campgrounds, and roads and trails leading to and from them.

Facilities for Lower-Income Groups.—National figures show that nearly half of all families and independent individuals in the United States have an annual income of \$1,000 or less. There is real need for simple but healthful recreation among this group; yet a survey made last year indicates that from this group came only 18 percent of the 2¼ million actual users of national-forest campgrounds.

The Forest Service feels that the national forests should be made more readily available to people in the lower half of the income scale. To do this certain things are necessary. Since among the lower-income group the cost of reaching free national-forest campgrounds and of stopping there is too great, the Forest Service is constructing organization camps where groups of people can take care of themselves

at minimum cost. Such camps will be made available to groups sponsored by welfare organizations and to groups and organizations such as farm and labor unions, Boy Scouts, Girl Scouts, Camp Fire Girls, and 4-H Clubs.

This is not a new or an untried idea. Comparable camps have for years been operated on national forests by municipalities, for example, and experience has indicated that with strict economy it may be possible (without interest) to amortize investments, pay for maintenance and management, and provide food, at a cost of about \$5.00 per week per person. This does not include the cost of such recreational leadership as might be provided by the National Youth Administration. Transportation, often beyond the reach of many people in lower-income brackets, can be provided by civic and other welfare organizations.

On national forests the construction of camps for low-income groups is given high priority. Many suitable locations are selected and reserved pending availability of funds for construction by the Forest Service or municipalities or organizations.

Income From Recreation.—Income derived from it is a major consideration in evaluating the importance of forest recreation. Many villages, towns, and counties in forested country receive the major income from this source. Thousands of farmers and businessmen in many forest regions have their markets and activities tremendously expanded through purchases made by recreational visitors. Thousands of local people add to their incomes by renting rooms or cabins. Many towns and counties find a chief tax source in summer homes and resorts. Estimates indicate that at least 250 million dollars are spent annually in communities on or adjacent to national forests as a result of recreation.

Zoning for Beauty.—To preserve natural beauty and charm, the Forest Service has zoned many roads, trails, larger streams, lake shores, and major recreational areas. Depending on the topography, cover, and kind and degree of use, these zones vary in depth from 200 feet to half a mile. Their purpose is to preserve the natural forest environment for the enjoyment and inspiration of national forest visitors. Within these zones such uses as cutting timber, grazing livestock, or establishing commercial enterprises are prohibited.

Appropriations, Expenditures, Auditing

FOREST SERVICE responsibilities and activities extend beyond the national forests. So do funds allotted to and expended by it. For the fiscal year 1938 they include, for example: From research appropriations, \$2,017,086; from appropriations for cooperation with

States in fire control and planting, \$1,674,180; from appropriations or services contributed by States, counties, associations, and individuals for fire control, slash disposal, improvement work, etc., \$2,894,517; from appropriations for work relief including C. C. C. expenditures for camps on State and private lands, for camps located on lands controlled by other government agencies, and for national forest camps, \$43,790,653; from appropriations of other government agencies, \$621,573; and \$668,664 for miscellaneous appropriations including repayments of deposits. Appropriations for protection, management, development, and extension of national forests were \$32,732,549. This included, in part, \$8,684,701 for forest highways (expended by Bureau of Public Roads); \$6,574,311 for acquisition of additional forest lands from regular and emergency appropriations combined.

Expenditures to carry on Forest Service activities during the fiscal year were derived from 31 appropriations, and were grouped in six broad classes. Break-down of Forest Service expenditures and receipts, and expenditures by sources, are included in (p. 55) Section Z, Administrative Statistics.

To insure use in conformity with purposes for which they are appropriated, funds are allotted to units and subunits by appropriation objects or purposes; each unit or subunit maintains accurate records by funds and by projects, purposes, and objects; encumbrances and expenditures are confined to amounts and purposes authorized; administrative controls and detailed budget and accounting records are maintained. Strict control eliminates the possibility of funds being expended for other than authorized uses. Administrative control and thorough and independent auditing extend from the Washington office to the 10 regional offices, 12 experiment stations, Forest Products Laboratory, Prairie States project, 146 forest offices, 65 ranger districts, 38 State C. C. C. offices, and numerous C. C. C. camps.

Not only are there accounting and fund control records, but expenditures are broken down, without reference to appropriations into 56 major cost-accounting captions. These reflect the actual use of appropriated funds in connection with individual resources. They, and cost records kept by projects, supply the cost data used in administration and the data required by the Secretary, the Bureau of the Budget, Congress, and other agencies.

Total expenditures for all purposes by the Forest Service during the fiscal year were \$84,399,222. Receipts were \$4,671,133. Of this, \$1,178,883 was, under existing legislation, returned to the States.

New Legislation

THE year's forestry legislation among States has been compiled by individual States and may be requested from the Forest Service, Washington, D. C. The following acts affecting the Forest Service were enacted during the third session of the Seventy-fifth Congress.

APPROPRIATION ACTS

First deficiency, act of March 5, 1938 (Public, No. 440), includes \$1,279,417 for emergency fire fighting, fiscal year 1938.

Civilian Conservation Corps, act of April 25, 1938 (Public Resolution No. 88), appropriates \$22,000,000 for fiscal year 1939 and reappropriates all unobligated balances from fiscal year 1938.

Independent Offices Appropriation Act, act of May 23, 1938 (Public, No. 534), appropriates \$226,331,000 for the C. C. C., fiscal year 1939.

War Department Civil Appropriation Act, act of June 11, 1938 (Public, No. 591), includes \$82,000,000 for flood-control work in fiscal year 1939, with \$7,000,000 for the Department of Agriculture.

Department of Agriculture, act of June 16, 1938 (Public, No. 644), makes regular appropriations for fiscal year 1939.

Emergency relief, act of June 21, 1938 (Public Resolution No. 122), carries \$1,712,905,000 for July 1, 1938–February 28, 1939, with \$4,142,857 project funds and \$207,143 administrative funds for the Forest Service.

Second deficiency, act of June 25, 1938 (Public, No. 723), includes \$1,000,000 for repairing flood damage on national forests in California.

OTHER ACTS

Act of February 12, 1938 (Public, No. 428), authorizes purchase of lands for addition to Tahoe National Forest, in California and Nevada.

Act of May 11, 1938 (Public, No. 505), provides for acquisition of lands from receipts of Cache National Forest, Utah.

Act of May 26, 1938 (Public, No. 546), provides for additions to the Kaniksu National Forest, Wash.

Act of May 31, 1938 (Public, No. 559), provides for withdrawal from mineral entry of certain lands within Cleveland National Forest, Calif.

Act of June 15, 1938 (Public, No. 615), provides for additions to Black Hills National Forest, S. Dak. and Wyo.

Act of June 15, 1938 (Public, No. 624), provides for additions to Ochoco National Forest, Oreg.

Act of June 15, 1938 (Public, No. 629), relates to duties of Mount Rushmore Memorial Commission, South Dakota.

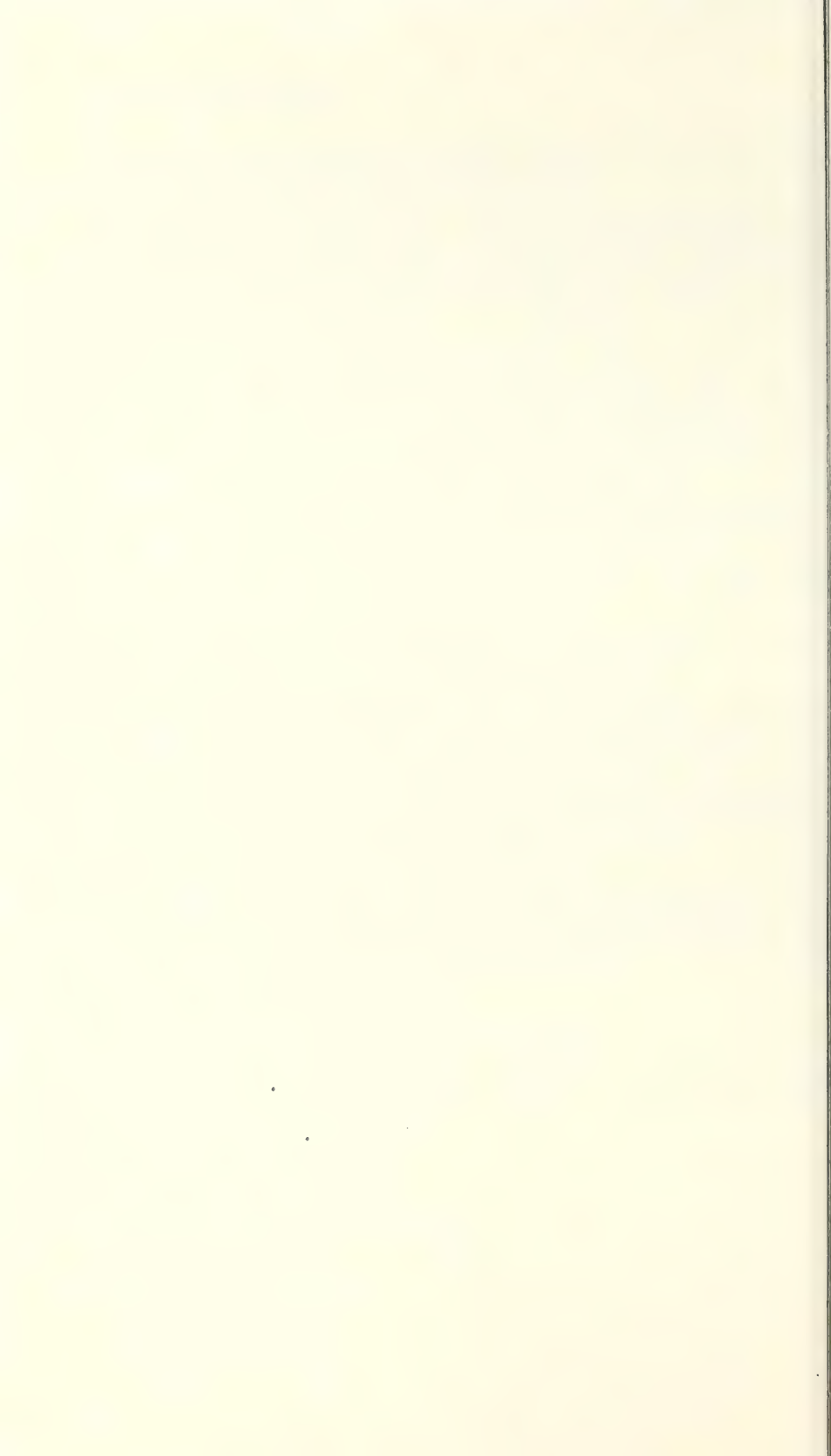
- Act of June 15, 1938 (Public, No. 634), provides for the purchase of lands from receipts of San Bernardino National Forest, Calif.
- Act of June 20, 1938 (Public, No. 679), provides for additions to Rio Grande National Forest, Colo.
- Act of June 20, 1938 (Public, No. 683), provides for additions to Trinity National Forest, Calif.
- Act of June 22, 1938 (Public, No. 692), provides for additions to Inyo National Forest, Calif.
- Act of June 22, 1938 (Public, No. 693), provides for additions to Mammoth National Forest, Calif.
- Act of June 22, 1938 (Public, No. 694), provides for additions to Inyo National Forest, Calif.
- Act of June 25, 1938 (Public, No. 748), authorizes purchase of lands from receipts of the Nevada and Toiyabe National Forests, Nev.
- Act of June 29, 1938 (Public, No. 778), provides for establishing the Olympic National Park, Wash.
- Senate Concurrent Resolution 31, adopted June 13, 1938, creates a joint Congressional committee to study the forest situation in the United States.

Administrative Statistics

THE Forest Service has for years compiled basic statistical material for administrative use and certain other purposes. In tabular form some of it has for years been included in the annual report, but much of it has not. To make more of it more readily accessible, this material is now assembled under the heading Administrative Statistics. Section Z, Administrative Statistics, contains tables comparable to those included in last year's annual report, plus certain others. Key figures from these tables are incorporated in the text of the current report. If details are desired they may be obtained by writing for a copy of Section Z, Administrative Statistics. Requests should be addressed to the Forest Service, Washington, D. C.

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REPORT OF THE CHIEF
OF THE FOREST SERVICE

1939



U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

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Report of the Chief of the Forest Service

1939

UNITED STATES DEPARTMENT OF AGRICULTURE,

FOREST SERVICE,

Washington, D. C., October 1, 1939.

HON. HENRY A. WALLACE,

Secretary of Agriculture.

DEAR MR. SECRETARY:

In recent annual reports I have stated and restated the broad situation with respect to forest lands, which total one-third our land area.

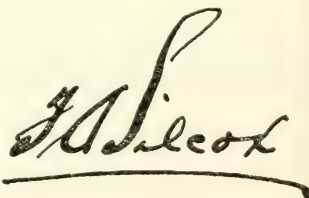
In last year's report I indicated that if without delay an adequate forest policy were adopted and action programs were started, there should be no excuse for a permanent timber shortage of national proportions. But I called attention to the serious situation in many regions already facing depletion of valuable species and grades. I emphasized the need to protect and manage forests we have. I urged growing more and better forests to provide employment, increase mass production power, balance the drain from usable forests with new growth in them, and make an investment in security for the Nation and its people whether or not markets for more forest products were in sight.

Three-fourths of all our commercial forest land is privately owned. It includes the most accessible and most easily logged land, and nearly three-fifths of our saw timber. It furnishes more than 95 percent of the timber we cut. Directly or indirectly it supports about one-tenth of our people. Most of it is not managed to yield continuous harvests. Most of the usable accessible virgin timber may be gone before enough usable second growth to meet our needs becomes available. As a Nation, we must find means to insure continuous harvests, and to close this gap.

This annual report appraises certain problems facing industrial and farm owners of forest land, and certain ways these problems may be solved. It indicates certain existing relationships between industrial and farm-forest owners, State and other Federal agencies, and the Forest Service. It briefs the role of community, State, and Federal ownership of forest land, and makes plain that Forest Service stewardship extends beyond the national forests.

My current annual report does not attempt to cover all things done, or all those that need doing, before the United States can be on sure ground with respect to its vast forest resource. Within practical limitations, this will be done in a special report to be submitted to the Joint Committee on Forestry. As you know, the President asked that this committee recommend to Congress legislative and other measures needed to help solve the country's forest problem.

Sincerely,



Chief.

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Introduction

NATURAL resources such as land, water, forests, forage, and minerals are sources of raw materials and other necessities of life, and of employment and income.

In the United States, forests are one of the more important natural resources. They help control floods, which take yearly tolls of human lives. They help prevent erosion and duststorms, which cause widespread human suffering. Protecting land, forests also rebuild worn-out soil. And they affect city people who manufacture and sell furniture, for example; stockholders and employees of carriers over which it is shipped; and farm people who depend on forests for such things as building materials, firewood, and fence posts.

Merchantable standing timber in the United States has been reduced by about 1,000 billion board feet since 1910. If this vanished timber were now available as growing stock it would be capable of producing on a continuous basis one-half as much saw timber annually as we cut during 1936.

Forests were abused in this process, and in earlier ones. Millions of acres were sorely depleted. We inherited our forests, but we have not even maintained them. Yet man can reproduce and grow forests. He can also harvest them repeatedly, and maintain and build them up. In these respects forests are unlike minerals.

Used, but managed this way, commercial forests act as permanent reservoirs for wood and work. They add to that social and economic security the desire for which motivates wage earners, business and professional men and women, agriculture and industry, local as well as State and Federal Governments. Forests become, then, a basis for better living.

This kind of managed use is a key to the present situation with respect to commercial forest land in the continental United States. Alaska excluded, this land totals 462 million acres. It has enormous present and potential values. Most of it is privately owned, but it performs many public services. In the aggregate, the value of those services exceeds private values. But most operators on private forest land do not practice this managed use.

As a Nation we would be better off with more rather than fewer forests. This is true whether or not markets for more forest products are in sight. But even today the drain from usable forests exceeds their growth, and current conditions indicate that most of

the remaining accessible virgin timber may be gone before enough usable second growth to meet real needs becomes available. And as a Nation we have not closed this gap, or insured continuous forest harvests.

This is a public obligation. It must be met. So must certain other public, and private, responsibilities and obligations that affect forests and forest land. The three-point program suggested in my annual report for 1938 indicates a way to do this. In brief, the program includes:

(1) Cooperation. Public aid has been extended to private owners of forest land for years. It has applied to fire protection, for example; to basic research, including the forest inventory and problems involving reforestation, forest economics, and forest management; to methods of manufacturing, processing, and using forest products; to ways of retaining old and developing new markets for them. It has also been applied to such problems as forest taxation, forest credits, and forest extension.

This public aid has been helpful. With it, and with many of the things private owners have done and for which they deserve credit, real progress has been made. Both public and private cooperation must be continued and extended if problems that affect private owners and the public welfare are to be solved successfully. But decades of experience indicates that cooperation alone cannot safeguard public interests and values involved in privately owned forest land. Nor can it protect private interests. Something more is needed.

(2) Public regulation of cutting practices on private forest land is necessary in order to protect public interests. With it private owners cannot, as the majority still do, nullify much of the effect of public aid in forest-fire protection, for example, by destructive cutting. With safeguards against bureaucratic action, public regulation will also safeguard interests of leaders among private forest land owners who have now adopted forest practices better than those Nation-wide regulation might set; these private owners and others who may follow their example will then be protected against unfair competition from the majority that still operate on a cut-out-and-get-out basis.

The need for public regulation of cutting practices on privately owned forest land is now recognized, in part, by State legislation in Louisiana, New Hampshire, Idaho, and New Mexico. Practices of companies and individuals who operate on national forests, from which they harvested 1,290,561,000 feet of timber last year, have always been subject to public regulation. There is need for Nation-wide application of some form of public regulation to cutting practices on private forest land.

(3) Public ownership and management. Communities and States as well as the Federal Government should be adequately represented in public ownership and management of forest land. The degree to which this ownership and management may apply should be determined by the extent to which public interests are protected by private owners.

Privately Owned Forest Land

THREE-FOURTHS of all commercial forest land in the United States is privately owned. It helps protect the water resource and cultivated cropland. It includes the most accessible and easily logged land, nearly three-fifths of all remaining saw timber, possibly nine-tenths of the potential timber-growing capacity of the whole country. It furnishes more than 95 percent of the timber cut. Directly and indirectly it supports about one-tenth of a population of more than 130 million people. Some 202 million acres of commercial forest land are in industrial and nonfarm ownership. Farmers own 139 million acres.

Privately owned forests, and problems facing private owners, are major factors in the Nation's forest situation.

Problems Facing Most Private Owners

THERE are many problems that face most private owners of forest land. The basic one is that, in most regions and in the country as a whole, mill capacities are way above the power of accessible land to produce usable forests. This limits the time operations may continue at present levels. Another basic problem is the necessity to operate at a profit. It costs money to grow enough timber in time to keep operations going. This has never been done by most private owners. Instead, most profits have come from liquidation.

One problem is to protect forests from fires, insects, and diseases; another obvious one is to extend markets. This emphasizes the paradoxical situation of the tremendous need for new buildings and repairs on the one hand, and on the other of forest-industry plants that are operating at only about one-half their mechanical capacities. Forest taxation is a problem. So are tax delinquency, insurance, credits at low interest, freight rates, and research.

The following discussion is confined to certain problems that affect most private owners of forest land, and to certain measures that may help solve them.

Fire protection.—Without adequate fire protection existing forests may not be preserved, new forests may not be established or brought to harvest, forest land may not be kept productive, labor may not have forest and forest-industry jobs. The Federal Government cooperates through States, and they cooperate with private owners, largely because the public starts 75 percent or more of all forest fires.

Much of this cooperation has been through and with associations of private owners. Membership in these associations has often been on a voluntary basis. But all property owners in cities help pay for fire departments there. No city owner can refuse to pay taxes just because he thinks he may not have a fire. The present trend in the South, where most of the unprotected areas are located, is to organize fire protection on a county basis; to make assessments compulsory on all forest-land owners within the county; and to channelize all public funds through the State.

Last year cooperative forest-fire protection covered 308,458,000 acres in 40 States and Hawaii. The area burned on protected land was 2,623,270 acres. Damage was \$7,179,630. Reported expenditures included \$1,952,341 of private funds and \$6,058,212 of public funds. Of the latter \$4,322,011 was State and \$1,736,201 was Federal. This Federal aid was greatly extended by construction of fire-control improvements and control of fires by the Civilian Conservation Corps on State and privately owned forest lands. Actual value of this C. C. C. work was about \$17,000,000. It was a vital factor in cooperative forest fire protection.

But forest-fire protection is still a major problem. Nearly two-thirds of the 222,356 fires reported on all private and State-owned lands last year were on 161,948,570 acres outside organized protection districts. And results were spotty on many protected areas; excellent on some, but poor on others.

No successful solution of this problem is possible without increased funds. In addition to what the C. C. C. normally does, estimates indicate that \$18,500,000 is needed annually. This is nearly \$10,490,000 more than was spent last year. Parts of this increase are responsibilities of private owners and the States, but part of it is a Federal responsibility. Federal aid should be increased to \$9,000,000 annually.

Protection from insects and diseases.—Losses from forest insects and diseases generally exceed those from fire. Blight has practically destroyed the once valuable American chestnut as a source of commercial forest products. Gypsy moths do serious damage among com-

mercial hardwoods in parts of the East. Between 1931 and 1935 western pine beetles killed 15 times as much ponderosa pine in Washington and Oregon as was destroyed by fire there. White pine blister rust is killing millions of seedlings and saplings and threatening commercially valuable sugar pine and western white pine in five Western States every year.

Like fires, forest insects and diseases do not respect State lines or property lines. Like fires, they should be discovered, attacked, and brought under control quickly. As with fires, work by the C. C. C. has been valuable, but adequate protection against forest insects and diseases requires more private, State, and Federal facilities and funds than normally are made available annually.

Markets.—The United States uses more than one-fourth of the wood that, in all forms, is consumed in all the world. Foreign markets for forest products are important, but they are and always have been small in relation to the domestic market.

Lumber accounts for about one-half of the wood used in the United States. In 1923 we consumed some 40,000,000,000 feet of it. In 1937 consumption was not far from 27,000,000,000 feet. This indicates the need for regaining old and developing new domestic markets. Without them our commercial forest resource cannot be used to its fullest extent.

Fortunately all analyses indicate that needs for lumber and other forest products are much greater than the quantity that has actually been used annually during the past decade. This is reflected in housing, including repairs and alterations. Four-fifths of our dwellings are of all-wood construction. It is reflected along 420,000 miles of railroad tracks resting on wooden cross ties that have been renewed at the rate of more than 50,000,000 a year; in mine supports that guard the lives of 750,000 miners; along nearly 90,000,000 miles of telephone and telegraph wires carried above ground on wooden poles. It is also reflected on most of our 6,800,000 farms; in upkeep of barns and other buildings there, and in 400,000,000 wooden fence posts that need replacing each year.

Most people think of wood in terms of such things as houses, furniture, boxes, and the like. And perhaps in terms of potash, charcoal, sawdust for circus rings, linoleum, telephone receivers, and phonograph records. But it also has a tremendously wider range of uses in physical and chemical forms. They already include movie films, for example, and lacquers, dyestuffs, distillates, and rayons; gas, alcohol, wood silk, and wood wool; toothpaste tubes, combs, and sausage skins.

In Europe, raw wood sugar is used for animals and humans. Fermented with yeast to form ethyl or grain alcohol, it may be used in

place of gasoline. In the United States there is made a laminated substance that seems to stand somewhere between plywood and a true plastic. Still more or less a trade secret, apparently reliable reports claim that this material has been tested, as a one-piece airplane fuselage, for more than a year. According to reports, this material can be molded in a die, without high temperatures or enormous pressures, in less time than is needed to buckle on the present airplane's skin; it does not chip or corrode, resists water and acids, and in certain respects is stronger than aluminum alloy.

This substance is one of thousands of new uses for wood that researchers and technicians have developed. Yet with all the progress made, we have just scratched the surface. In chemical possibilities alone, wood still holds many secrets in its fibers, its cellulose, and its lignin.

Manufacturers and retailers and their associations have helped hold old markets for forest products, and develop new ones. So has the Forest Service, largely through its Forest Products Laboratory. All these efforts must be continued and intensified. But the problems of markets for forest products is part of the paradox of a whole economic system that, despite idle capital, huge manufacturing capacity, reserve labor, and an abundance of the necessities of life, seems unable to supply enough of these products to millions of needy people. A basic factor in this whole problem is low mass purchasing power. Some way must be found to raise it.

Foreign competition.—In 1938 the United States exported logs, hewed and sawed timbers, lumber, lath, shingles, paper, paper base, and articles manufactured from wood and paper that were valued at \$93,398,607. But imports of these products were valued at \$230,970,546.

The value of 1938 exports of wood pulp, pulp and paper-base stock, and articles manufactured from pulp stock and paper, included in these figures, was \$37,567,962. The value of imports, also included, was \$199,332,890. These imports, coming in free of duty, accounted for more than two-thirds of the wood pulp, pulp stock, and pulp products we consumed.

Thus foreign competition and domestic consumption have a bearing on our available supply of soft pulpable woods and the relation of them to world-wide pulpwood resources.

Even a brief survey of our soft pulpable wood resources in relation to world supplies brings out very clearly the need to conserve and build up our forest resources. Available reserves of such species as spruce, hemlock, and the pines are limited. Producing countries that export heavily, like Norway, Sweden, and Finland, cannot increase their pulpwood production very much without eating into their forest capital. This they are wisely loath to do. Mill capacities

or directly tributary to eastern Canada are beyond the capacity of easily accessible forests to sustain, and immediate supplies are getting more remote. There is practically no commercial supply in the East or in Africa. There is little or none in South America or Australia.

The only world reserves of soft pulpable woods are in (1) the Union of Soviet Socialist Republics, (2) southeastern United States, and (3) a Northwest that includes British Columbia and Alaska. If, as competent observers believe, the Soviet Union must and will use practically all the wood pulp she can produce for the next two decades, any marked expansion in use elsewhere must come from the last two reserve supplies just mentioned.

World production of wood pulp was 16,719,000 short tons in 1931. In 1937 it was 26,121,000 short tons. This increase, more than 56 percent in 6 years, emphasizes the need for adequate management of all forests that supply pulpwood. An increase of nearly 50 percent in domestic production of pulp in the last 6 years emphasizes the need for management of pulpable forests in the United States. So does the fact that in addition to 40 or more pulp mills, of which 10 of the largest have been installed during the last 5 or 6 years, there are more than 10,000 sawmills and other wood-using industries that also depend on southern forests for raw-material supplies.

Of our own reserves, southeastern Alaska has enough soft pulpable woods, mainly hemlock and spruce, to provide continuous production for seven mills with a daily capacity of 500 tons each. Our northwestern forests grow rapidly. So do those in the South, where pulp developments provide a market for forest thinnings that make increased growth possible. The pulp industry there can use wood that is of relatively little value for lumber. Most of its production is now confined to kraft, wrapping paper, paper cartons, and the like, but a new plant at Lufkin, Tex., plans to produce wood pulp for newsprint.

If fire prevention and sustained-yield forest management become general with pulp and other forest industries, if their requirements and those of the many other forest industries are coordinated, and if growing stock in the South is built up, the South and the West may be able to count on continuous harvests of more pulpwood than is indicated by the planned capacity of existing pulp mills there. As a Nation we may then have a margin for export.

It may be necessary to import forest products so that foreign nations can pay for American-made automobiles and other things we export to them. Despite conditions cited, it even may be necessary to import free of duty wood pulp manufactured in northern Europe with wages that average about 30 cents an hour compared to wages that average 82.6 cents an hour in Oregon and Washing-

ton—pulp that, because of wage and other costs of American bottom and without taking depreciated currencies into account, European manufacturers can ship to our Atlantic seaboard for around \$3.5 per ton less than shipments can be made to that seaboard from Puget Sound and Columbia River points. For foreign competition is complicated and far-reaching. Besides hundreds of thousands of raw and manufactured articles, it involves such things as exchange rates, depreciated currencies, wage scales, and international relations.

Freight rates.—One-third of all our saw timber is on 6 percent of our commercial forest land. This land and timber are in western Oregon and Washington. Forests there include most of the remaining accessible virgin old growth. This virgin old growth is going faster than usable second growth sufficient to meet real needs is coming on. The East, with three-fourths of the land and four-fifths of the people, has less than one-third of the commercial saw timber. Many of its regions and localities already face forest depletion with respect to valuable species and grades.

Railroad freight on lumber from west coast points to Chicago costs around \$20 per 1,000 feet. Freight by water from the West to east coast markets by way of Panama Canal costs around \$14 per 1,000 feet. In 1936 transcontinental hauls of forest products included 4,344,218,000 feet of lumber that originated in Pacific Coast and Rocky Mountain States. This was equivalent to more than 173,700 carloads. It was 19 percent of all our domestic lumber shipments that year. Other long-haul shipments of lumber, including those from the South and Southeast to Midwest and Lakes and North-eastern States, totaled 4,694,568,000 feet. This was 20.5 percent of all our domestic lumber shipments that year.

Regional depletion has developed long and expensive freight hauls. It has been accompanied by waste in the woods, particularly of species and grades that, with lower selling prices, cannot be shipped over long hauls at a profit. The problem is serious to consumers, for incomes of all salaried people and wage earners make up, in the aggregate, 65 percent of the national income. Lumber and other forest products have become luxuries to many of these people. This has had widespread adverse effect on markets (p. 6).

Action to rebuild, restore, and manage the basic resource on forest lands tributary to heavy centers of population and demand offers one solution to this problem. Most of these lands are privately owned. Many of them are now in such condition that they do not offer attractive immediate returns for private capital. Most private owners are doing little or nothing with these lands. The existing set-up does not permit use of relief labor for much of the work that is necessary.

There is need for a device that will make it possible for the Federal Government to employ labor and, with adequate safeguards,

restore these and other forest lands to productivity, and manage them. This might be done through such unemployment relief and certain other Federal funds as may be available. Annual rentals might be paid to owners, and they might retain title to their lands. Recapture of all or part of the monies expended might be accomplished from use of the land and sales of its products.

Research.—Most industries know that real money spent for basic research develops new products and methods, better old ones, and helps do better jobs than could be done by trial-and-error methods.

Some large forest-products corporations and their associations conduct forest research. But there are about 3,500,000 farmers who own commercial forest land in the United States. It is out of the question for them, and for most of the 1,000,000 industrial and nonfarm owners, to conduct the forest research they need. And research is essential to public management of community, State, and Federal forests.

Research by the Forest Service is primarily concerned with:

1. Uses of forest land and methods of growing timber. These require knowledge of climates, which vary from arctic to tropical; knowledge of effects of climate and wide ranges of soil and topography on several hundreds of tree species occurring in an infinite variety of combinations; and knowledge of such things as planting and fire protection.

2. Methods of cutting and removing forest-land crops with the least waste and a minimum of damage, on a basis of permanent production.

3. Methods of processing and using raw wood and its products and byproducts. This includes knowledge of strength and other physical, mechanical, and chemical properties of wood; of present and potential markets, particularly with respect to large volumes of low-grade material now being produced; of new uses for woods now used and those not now used; of how lumber and other forest products may be manufactured and processed best.

4. Economic aspects of managing forest land; of harvesting its resources; and of manufacturing and processing, distributing, and using them. This includes such things as forest taxation; tax delinquency; forest-fire insurance; stumpage, log, and lumber prices; where our forests are, how fast they are being depleted, how fast they are growing, how fast they can be expected to grow, and present and prospective requirements for forest products.

5. Forest influences. The effects of forest land and its vegetative cover on the water resource, for example. Effect of use of forests, game, and wildlife, and of recreation, on each other, and on industry, agriculture, and local and national welfare.

Forest Service research concerning such things as prices, costs, and uses of forest products has been of direct value to manufacturers, dis-

tributors, and users of forest products. Research in fire protection and forest management, for example, helps solve problems that are vital to private and public forest-land owners generally. Results are made available to private, community, State, and Federal agencies alike. Facilities for research work that is sorely needed are no longer adequate. They should be extended.

Wages and hours.—Recent legislation with respect to wages and hours has created new and often perplexing situations for many private forest-land owners, and for many operators on both private and public forest lands. This situation will affect costs of production, employment, profits to owners and operators, and stumpage prices, for example. It is acute in regions like the South, where there are many small mills and where much small timber is being cut. This has a direct bearing on forest conservation. The Forest Service is now conducting an investigation of this situation. The object is to determine what the effects of recent wage-hour legislation are, and whether it will be possible to counteract increased costs with economies resulting from better operating methods and forest practices.

Taxation, tax delinquency, insurance.—There is widespread agreement that operation of existing State and county property-tax laws often leads to tax delinquency and neglect of cut-over lands, and that deferred-yield forest properties are often penalized because these taxes come every year while forest income may not.

There is no cure-all for these taxes. Taxing land is a function of State and local governments, but cooperative investigations, made by the Forest Service in an effort to encourage better forest practices, indicate that it is often possible to (1) reduce property taxes on forest properties through savings made by such improvements in organization and functioning of local government as will not curtail essential public services, (2) improve tax administration, and (3) apply adjustments to forest properties definitely managed for deferred yields.

In many counties there are owners who, after having defaulted for years in payment of current property taxes on cut-over forest lands, are permitted to redeem them at bargain prices. This penalizes owners who pay taxes regularly. Unless there is equitable taxation that will let private owners grow timber crops, and unless it is equitably applied, public ownership seems essential if something constructive is to be done with these lands.

Conservative estimates indicate that in Oregon and Washington the amount of forest lands forfeited for unpaid taxes rose from approximately 1,140,000 acres in 1933 to more than 1,850,000 acres in 1938, while forest lands tax-delinquent for 3 years and more rose

from about 3,560,000 acres in 1933 to more than 5,370,000 acres in 1938. Tax delinquency of cut-over forest lands rose in three Lakes States from 6,000,000 acres in 1929 to more than 20,000,000 acres in 1939.

This is a vicious circle. It adds to the taxes of property owners who pay, and helps force more forest liquidation. It also encourages the owner who pays taxes to seek compromises. Both are due in part to operation of State and county property-tax laws. Some cut-over lands have additional levies imposed to finance drainage of crop-lands. These levies are usually prorated over all forest and other land within the drainage districts, whether that land is benefited or not.

Among remedies which seem applicable to this situation in the Yazoo delta of Mississippi are: (1) Legislative action to readjust drainage taxes in accordance with actual benefits to the properties concerned; (2) improvement of laws and practices in respect to assessment so that all land and timber may be taxed on an equitable basis; (3) abolition of special school and road districts as rapidly as their outstanding debts can be provided for, with establishment of the county as the basic unit of financing and administration; (4) increased State support of school and road functions. It may be possible to apply these remedies elsewhere.

Except in terms of human suffering, millions of acres of cut-over tax-delinquent forest lands have passed from private to public ownership without much cost. But public ownership alone does not alleviate the situation. Adequate contributions in lieu of taxes are necessary. Some States recognize this by making payments, usually at specified rates per acre, for forest lands they and their counties take over. Federal ownership carries comparable obligations. There is definite need for more uniform application of a simple and direct way to meet them. It should include allowances for differences in character and condition of forest land in different counties. A plan along these lines has been developed. As proposed, it applies to conservation lands under the jurisdiction of the Department of Agriculture.

If it can be applied to forests at reasonable costs and on a sound basis, fire insurance might provide relative freedom from financial losses that are often serious to forest-land owners. Studies by the Forest Service indicate that, with certain underwriting safeguards, forest-fire insurance should be practical in the Pacific Northwest and in the Northeast. Serious recent fires in the former region, and last fall's hurricane in the latter, will probably delay immediate action, however.

Solutions to Some Farm-Forest Problems

MOST farmers are confronted with the same problems that most industrial and nonfarm forest owners are. But there is a group of problems that because of certain conditions becomes of particular importance to owners of farm forests.

One of these conditions is that forest ownership is more widely distributed among farmers than it is among industrial owners, and that individual ownership is generally in smaller tracts. Pressure to cut farm forests for cash to buy such immediate necessities as food and clothing is also greater. This sacrifices values and throws unripe timber on the market more often. Methods and facilities used by most farmers for measuring, grading, pricing, and manufacturing forest products, and for selling them, are less effective than those commonly available to and used by larger industrial forest owners. It is also more difficult for the small owner than it is for the large one to get trained and experienced foresters, loggers, and millmen, and to locate and keep profitable markets.

Pooling of resources through associations is practiced among industrial and other large forest-land owners and operators. It offers what is perhaps one of the best ways to overcome many handicaps and problems that beset farm-forest owners.

FARM-FOREST COOPERATIVES

Last year the Farmers Federation, Asheville, N. C., marketed more than 1,000 carloads of pulpwood, about 15 carloads of locust fence posts, and 6 carloads of decoratives like rhododendron. Reports indicate that this federation has for years handled its members' farm-woodland products satisfactorily and successfully.

Cash incomes of farmers who participate in the Otsego Forest Products Cooperative Association at Cooperstown, N. Y., have been raised from \$400 to \$533 by that association's woods activities. The community has also benefited. Woods work made available to unemployed men reduced its relief costs from \$279 in January 1938, to \$40 in March 1938. This was a portion of the year in which there is normally an increase in relief expenditures.

This association was developed with the help of the Northeastern Forest Experiment Station, which wanted to determine basic methods and principles of organizing small forest-owner cooperatives. The cooperative now manages forest properties for some 300 mem-

bers. Most of them are farmers. Aided by a loan of \$159,000 from the Farm Security Administration, this cooperative also manufactures forest products at its own plant, and markets them for its members.

Forest Products, Inc., of Groveton, N. H., has a loan of \$100,000 from the Farm Security Administration. This cooperative sells but does not manufacture forest products. Nor does it manage farm forests. To encourage cropping the resource, a timber inventory has been completed within its territory by the Forest Service and the C. C. C. This inventory covers 288,000 acres. It includes more than 2,000 farm wood-lot owners. Data have been turned over to extension foresters for New Hampshire and Vermont. They are drawing up individual forest-management plans.

Comparable surveys of 21,000 acres in 38 tracts, and 30,000 acres in 900 tracts, have been completed in cooperation with the West Virginia Forest Products Association of Morgantown, W. Va., and the Tioga County Woodland Owners Association of Owego, N. Y., respectively. Extension foresters of these States are also making individual forest-management plans. State agencies are fostering cooperative management of farm woodlands, and marketing products from them, in the Yuba section of southwestern Wisconsin. Similar activities are of record in Clarke County, Miss., and elsewhere.

Farm-forest cooperatives may help their members through:

Farm-forest extension.—This in itself is a cooperative undertaking by the Forest Service, the Extension Service, the Soil Conservation Service, State agricultural colleges, and State forest and conservation departments. In 1938 it assisted farm-forest owners in 40 States and 1 Territory, employing 51 forestry specialists. But farm-forest ownership now seems important enough, and farm-forest problems acute enough, to justify the full time of trained foresters in each of some 600 counties.

Farm-forest extension also makes information about woodland protection and management available to cooperatives and owners. There are 21 million acres of farm forests that still need to be restocked; about 45 million acres that still need organized fire protection; around 75 million acres that must be rehabilitated if production on them is to be increased to reasonable levels.

Planting.—Last year 55,359,700 trees were produced and distributed at not more than cost to farmers, with the help of Clarke-McNary funds, in 41 States and 2 Territories. Additional planting of some 91,000,000 seedlings was made possible by the Soil Conservation Act; 9 million by the Tennessee Valley Authority Act. More than 46,500,000 trees and shrubs—of which 14,100,000 were for replacements over the entire project—were planted by the Prairie-States forestry

project (p. 27), which was continued by the Forest Service as a work-relief measure.

The Cooperative Farm Forestry Act.—This act carries an annual authorization for not more than \$2,500,000 for such things as: Raising and distributing trees, and planting them on farm woodlands; advising farmers with respect to protecting and managing farm forests and harvesting, utilizing, and marketing farm-forest products; investigations in farm-forestry problems and methods generally. Under this act Congress appropriated \$300,000 for the fiscal year 1940. Overall administration is lodged with the Soil Conservation Service. Parts of the appropriation are, however, available to the Forest Service and the Extension Service.

Agricultural Adjustment Administration's conservation program.—Under this program, and with the advice of the Forest Service, the Agricultural Adjustment Administration has set up standards and provided benefit payments for (1) planting trees on forest lands withdrawn from cultivation, (2) excluding livestock from farm woodlands, (3) cultivating and maintaining trees in recently established plantations, (4) silvicultural work in young timber stands, including creation of desirable conditions in forests and woodlands damaged by the New England hurricane, and (5) a naval stores conservation program that last year affected approximately 85 percent of naval stores production.

New England Forest Emergency Organization.—This organization was set up by the Forest Service. Its headquarters are in Boston, with branch offices in each of 6 States. Within territory hit by the 1938 hurricane, which according to estimates affected 30,000 farm-forest properties, the New England Forest Emergency Organization is advising and assisting owners to reduce abnormally high forest-fire hazards (p. 19). Under contracts it also buys hurricane-damaged timber delivered by farmers and other forest-land owners to certain specified points (p. 20).

Public leasing of private land.—This device might be used for employing labor to improve and manage existing farm woodlands, and to establish, improve, and manage forests on submarginal lands. Experts estimate that there are 75,000,000 acres of submarginal land still being farmed, with 450,000 farm properties involved.

Under terms of a public leasing bill introduced in the last Congress, preference in employment would go to landowners and occupants. All work would be paid for by the Federal Government. Each owner would be allowed not to exceed 500 acres on which reimbursement, derived from use of the land and sale of its products, would be fixed at not to exceed 50 percent of the cost of the work. For work done on land in any one ownership in excess of 500 acres, reimbursement at the

rate of 100 percent would be required. This proposed legislation has aroused widespread interest.

The extent to which farm forests contribute to owners, and to which submarginal lands may contribute after forests are established on them, is indicated by research conducted by the Forest Service and certain State agencies. Average annual gross income from woodlands was found to be \$122 per farm on certain Lakes States farms. Through better management and marketing it can be increased 50 percent. Other investigations in the Lakes States indicate an annual return of as little as \$1 an acre from combined grazing and forestry use of farm woodlands, but close to \$4 an acre—about the same as was yielded by the best open pastures—when woodlands were managed for forestry alone.

Records from Florida show net cash returns of \$2.40 per day to farmers who “gum farm” their own second-growth pine woodlands during slack periods that aggregate 70 to 80 days a year. A county agent in Polk County, Tex., reports a total cash value of \$478,332 for the 1938 timber crop there, compared with a total cash value of \$379,080 for that county’s 1938 cotton crop.

Research in Arkansas indicates that with the current average degree of understocking, an acre of loblolly pine there will, over a period of years, produce $4\frac{1}{2}$ times as much cellulose per acre per year as the average acre of Arkansas cotton does. It also indicates that, if fully stocked and fully producing, the average acre of Arkansas loblolly pine will produce 11 times as much cellulose per acre per year as is produced on the average acre of Arkansas cotton. These figures do not mean that every acre of forest land in the country is capable of producing as much cellulose in as short a time as can be produced in the South. That is impossible, because growing conditions vary, as do opportunities for returns, between regions and between localities. But the figures do mean that people and communities near submarginal lands on which forests are restored and improved may look for more stable and higher returns from harvesting continuous forest crops.

Some Relationships

UNLIKE minerals, forests are living things. They grow according to nature’s laws. They grow irrespective of property lines; on public as well as private land. Man can help nature reproduce forests, much as he can with cultivated crops. He can protect and improve them, and harvest them repeatedly.

As grass and browse, forage occurs on many mountain slope above commercial forests. It also occupies much of the same land commercial forests do. Wherever this forage grows, it often help support domestic stock owned by farmers, ranchers, and others. And horses, cattle, and sheep using pastures, as well as those using grass and browse on mountain ranges, must be controlled if both cultivated and wild forage are to be kept continuously productive and cropped.

Big game also commonly occupies much of the same land commercial and other forests do. This wildlife finds shelter and food there. And scenic charm and recreation—to which forests, forage and wildlife contribute—are as much a part of public and private forest-land values as is the role these lands play in regulating and conserving soil moisture and saving farms from damage by floods and silt-laden streams.

Close relationships also exist between the Forest Service and the Agricultural Adjustment Administration, Soil Conservation Service, Farm Security Administration, Bureau of Entomology and Plant Quarantine, Federal Surplus Commodities Corporation, Bureau of Agricultural Economics, and Extension Service. Comparable relationships exist with the Bureaus of Agricultural Chemistry and Engineering, Animal Industry, Plant Industry, and with the offices of Land Use Coordination and Experiment Stations. These relationships help each bureau and agency redeem its specific responsibilities. They also help the Department with respect to its local, regional, and national responsibilities.

On mutual and interrelated problems the Forest Service also cooperates with and receives cooperation from State and county land-planning boards; agricultural colleges; farm cooperatives; State foresters; forest-fire protective, recreational, water users', and livestock owners' associations, and those of manufacturers of forest products; the Grazing and National Park Services and the Biological Survey of the Department of the Interior; the Disaster Loan Corporation; the Department of Labor; the Reconstruction Finance Corporation; the Civilian Conservation Corps of the Federal Security Agency; and the Public Works and Work Projects Administrations of the Federal Works Agency.

The Forest Service is and for more than 30 years has been regionalized and decentralized. Seven percent of its 5,500 regular employees are in the Chief's office, in Washington. They include members of the staff, which establishes policies and standards that apply to the whole Forest Service. The staff also checks on policies and standards, and on performance. Ninety-three percent of all permanent Forest Service employees are in the field. The National forests are grouped into 10 regions, with a regional forester in charge of each. The Forest Service also has 12 regional experiment stations.

Each of these, as is the Forest Products Laboratory at Madison, Wis., is in charge of a director. Regional foresters and directors act also as consulting members of the Chief's staff.

One purpose of this decentralized organization is to provide close and constant touch with local, State, and regional conditions. Another is to maintain such relationships there as will insure sympathetic and understanding consideration of current local problems.

Public Ownership and Management

OUTSIDE Alaska there are 462 million acres of commercial forest land in the continental United States. This, and the 168 million acres of noncommercial forest land, have many public values and perform many public services. One is to help prevent floods and erosion; another, to help protect the water resource.

Mississippi's Yazoo River Valley offers one of many examples of these two values and services. Forest land lost less than 0.5 of 1 percent of a 27-inch rainfall that occurred there in one 1931 storm, while cleared land lost 62 percent. In the same storm, cleared land lost 34 tons per acre of its topsoil, but protected forest land lost none.

Benefits like these are often worth more to the 130 millions of people than timber values are to the far smaller number who own most of the best forest land. These public services, and others that might be mentioned, indicate briefly why communities and States, as well as the Federal Government, should be adequately represented in public ownership and management of commercial and noncommercial forest land.

Community forests.—Cities, towns, villages, and counties get benefits from forest-land ownership and management. They receive direct returns from wood and other forest products. They also get intangible but very real public benefits from such things as outdoor recreation and pure and well-regulated water for domestic and other uses. Community forests also act as reservoirs for local employment.

Community ownership and management of forest lands has developed gradually but steadily. Communities now own and manage more than 1,500 forest areas, containing approximately 3 million acres. In many instances this ownership and management has been financially profitable. In many more instances it has been socially profitable. Community effort can help make such benefits available to many of the 20,000 counties and incorporated communities that are not forest-land owners and managers.

State forests.—States now own 19 million acres of forest land. Eleven million acres have been designated as State forests or parks. Ninety percent of this area is in New York, Pennsylvania, Minnesota,

Michigan, Montana, Idaho, Washington, New Mexico, Wisconsin, and Massachusetts. The South contains only 3 percent of existing State forests, but more than one-third of the country's commercial forest land. Much of the land in State forests in New York, Pennsylvania, and Massachusetts was bought from private owners. Much of that in other State forests was acquired through tax reversions or Federal grants.

State forests are protected from fire and trespass. The timber resource in many of them is under organized management. About 4 thousand acres are planted to trees annually. Recreation has been developed on nearly half of all State forests. Use, management, and protection of all of them have been greatly stimulated through emergency work done by the C. C. C. and the W. P. A.

Federal forests.—National forests were first created by reservations of public-domain lands, largely in the West. Nearly 11 percent of the publicly owned land in the national-forest system is now east of the Great Plains. Most of this has been purchased from private owners since 1933. Close to 52,000,000 acres of private land within national-forest boundaries often create difficult problems. They also increase costs of protecting, administering, and developing publicly owned resources.

There are now 175,843,405 acres of public land in national forests. This includes some 41,000,000 acres of grass, browse, and alpine country. In large part it is intermingled with more than 134,000,000 acres primarily in forest growth. All of this land is protected. The area burned annually fluctuates somewhat with climatic and other conditions, but the average for 1934-38 has been reduced 77 percent since the period 1910-14.

National forests are administered on a multiple-use basis. Slightly more than 46,000,000 national-forest acres are noncommercial forest land. A little less than 88,000,000 acres are commercial. Much of the latter is inaccessible, but last year 1,559,794,000 feet of timber was harvested, under regulation, from certain accessible portions of it. National-forest forage is used under permits by more than 6,500,000 head of domestic livestock plus their increase. And nearly 32¾ million people enjoyed wildlife and recreational opportunities and facilities on national forests last year.

National forests are reservoirs of work. They provided 13,436 man-years of it through the W. P. A. last year. They provided year-long work, and supervised training, for some 50,000 C. C. C. boys. Logging and processing national-forest timber furnished the estimated equivalent of 2,600,000 man-days of work. Owners employed close to 25,000 riders and herders to care for livestock grazed under permit. The number of people employed by summer resorts, dude ranches, and hotels catering to national-forest visitors is unknown,

but conservative estimates indicate that people spent more than \$200,000,000 during their visits to national forests in 1937. Besides its permanent force of some 5,500 people, the Forest Service has more than 11,000 short-term employees during most years. In all, nearly 4,000,000 people who live in and near the national forests are supported in whole or in part through public ownership and management of them and their resources.

A program for increase in community, State, and Federal ownership of forest lands was discussed in last year's report. The extent to which public interests in private forest lands are protected by private owners should determine, in a broad way, how far public ownership and management of forest lands need go.

Stewardship

IN addition to protecting and administering national forests (p. 36), the Forest Service has responsibilities with respect to public welfare inherent in all forest lands no matter who owns them. Many of these responsibilities have been mentioned. Ways by which, with help from other (p. 15) organizations, bureaus, and agencies, the Forest Service redeems its stewardship, are indicated by the following.

NEW ENGLAND'S HURRICANE AND HER FORESTS

In September 1938 New England was hit by a terrific hurricane. It left the most dangerous and widespread forest-fire hazards the region has ever known. On large forest tracts and on some 30,000 farm wood lots, it also left an estimated total of 3 billion feet of down timber. This was tragedy. For generations New England's forests have been a raw-material source for industry and labor. Her wood lots have helped owners pay taxes and send children to school and college, and have provided a measure of security for old age.

After the hurricane, forest-fire-hazard reduction was essential for public safety. Timber salvage was vital to economic welfare. New England appealed in this double emergency to the Federal Government. The President instructed Federal executive departments and agencies to give every possible assistance. He designated the Chief of the Forest Service, who had been authorized to call on all resources of the Department of Agriculture, to coordinate the work.

The Forest Service immediately set up the New England Forest Emergency Organization, with headquarters in Boston. It was staffed by experienced forest officers. Except on national forests, where the work is done by forces that protect and administer them,

the Emergency Organization's job was, and is, to handle hazard reduction and timber salvage in New England.

Town committees and State authorities, including State foresters who acted for Governors, helped draw up hazard-reduction plans. Decentralized organizations were established by the Organization in 6 States. Cooperation was offered by the Works Progress Administration and the Civilian Conservation Corps. Within a week after the central office was established, W. P. A. and C. C. C. forces were at work. They reached a peak of 25,000 men in November. By June 30, 1939, 338 miles of telephone lines for fire protection had been erected, fire hazards had been reduced to normal on some 45,537 acres adjoining heavily used roads, and 6,077 miles of roads and trails had been cleared. So had 29,844 high-hazard acres around towns and buildings. In cooperation with the Weather Bureau, 44 emergency forecasting stations had also been established, and daily fire-weather warnings were being issued and broadcast.

Meanwhile Congress included in the first urgent deficiency bill an appropriation of \$500,000 to continue forest-fire-hazard reduction on the White Mountain National Forest in New Hampshire and Maine and one of \$5,000,000 for forest-fire-hazard reduction work outside the national forests in New England. The latter appropriation was subject to a proviso that money used in any State must be matched dollar for dollar by the State or political subdivision.

These funds became available on April 1. The 5 million dollars made purchases of badly needed equipment and supplies possible. It also permitted establishing twenty-one 50-man camps and putting 2,500 men in mobile crews. They supplemented and complemented W. P. A. and C. C. C. forces. But the 1938 hurricane damaged 4,600,000 acres of forest land. On 600,000 acres of it fire hazards threatened homes, towns, and human lives. The New England Forest Emergency Organization reported 14,190 laborers working on hazard reduction outside national forests during June 1939. Of these, 3,418 were from the C. C. C. and 7,709 were from the W. P. A. It reported that more than 2,500,000 man-days of hazard-reduction work had been done to June 30. But it also estimated that at least 2 more years of intensive work will probably be necessary before emergency forest-fire hazards can be reduced to normal in New England.

Timber salvage, coordinated with hazard-reduction work, is cleared through the Northeastern Timber Salvage Administration. The Chief of the Forest Service is its administrator. With offices and facilities in each of six States, this administration was set up within the framework of the Federal Surplus Commodities Corporation.

Federal funds are made available as loans from the Reconstruction Finance Corporation through its subsidiary, the Disaster Loan Cor-

poration. These loans are based on market values of such salvaged hurricane-damaged forest products as, delivered by owners or their agents to designated points, are measured and accepted there by trained Northeastern Timber Salvage Administration employees. This Administration does no logging. It does pay owners after they or their agents deliver salvaged material. Immediate payments are on a basis of 90 percent of the fair market value of material that then becomes the property of the Administration and security for its loans. The Administration also agrees to prorate among participating owners such balances as may remain after completion of the entire salvage job, and after all expenses, including return of the loans with interest at 3 percent, have been paid. Grade specifications for acceptable sawlogs, tie logs, and pulpwood are standardized. So are prices paid for designated species, grades, and classes of material.

Estimates indicated that 1,643 million feet of the hurricane-felled timber was merchantable; that slightly more than 1,400 million feet of it might be salvaged if it could be stored in ponds or manufactured before serious deterioration set in; that private enterprises might salvage about 544 million feet, but that the Salvage Administration would probably have to function with respect to 873 million feet or more. On November 21, 1938, 60 days after the hurricane, the first logs were delivered. By June 30, 1939, and with the aid of town committees and cooperating town, State, and Federal authorities, 254 wet and 525 dry delivery sites had been established, and 11,451 purchase agreements had been signed. The latter represented 1,520,906,000 board feet in logs, plus 91,483 cords of pulpwood. Deliveries to June 30 totaled 474,985,000 board feet in logs and 7,013 cords of pulpwood. Payments to owners, covering most of these deliveries, totaled \$5,165,332. Contracts had also been signed with 274 privately owned sawmills, of which 238 were in operation; and 129,965,000 feet of lumber had been sawed, stacked for drying in storage yards, and invoiced.

During the summer it became necessary to confine delivery of logs to wet-storage sites and to those dry-storage sites where immediate sawing was possible. This was because of increases in stain and insect damage. In the meantime market conditions had been studied, as had possibilities for new outlets. The plan is to offer logs in ponds, where they can be held for long periods because deterioration is slight, for sale to local established industries. This should prolong operations, provide work for local people, and postpone the need for cutting undamaged forests. Lumber sawed largely because enough wet-storage sites were not readily available will be so disposed of as to prevent disorganization of local and other lumber markets as far as possible.

Timber salvage in New England is recovering an appreciable part of the wrecked forest resource there. Fire-hazard reduction is helping protect human lives and the remaining forest resource. Although perhaps 95 percent of timber losses were in white-pine stands, the white-pine seed crop was excellent during the 1938-39 season. This was fortunate. It means that, with adequate protection, white pine may confidently be expected to reclothe many damaged areas. Among measures that should help restore New England forests—nearly 75 percent of its area is forest land—and provide continuous yields of white pine and other species with grades definitely superior to those of the pine damaged by the hurricane are:

1. Wider knowledge among woodland and other forest owners of better facilities and methods for protecting and managing their forest properties generally, and for grading, manufacturing, and marketing forest products.

2. A better system of administrative districts to coordinate forest efforts and to afford technical assistance to forest agencies and owners.

3. Acquisition by local communities and the States of some of the more heavily denuded forest areas, and development and management of them as demonstration forests and as reserves for local employment.

4. Public leasing of private forest lands as an aid to unemployment to reforest them, and to manage them for owners (p. 14).

5. Public regulation (p. 2) to prevent exploitation of the forest resource.

RESEARCH

Research is a major responsibility of the Forest Service. Its general scope has been defined briefly on page 9. Relations to problems like uses and markets for forest products, wages and hours, taxation and tax delinquency, and farm-forest cooperatives have been indicated. Diversity of its projects, and stewardship with respect to certain of them, are indicated by:

The forest survey.—This stock-taking project is providing authentic information basic to forest land-use planning and management of regional and country-wide forest resources for continuous production. It is gradually showing what is necessary to insure ample permanent timber supplies. The work is done on private as well as public forest lands. Results are available to individuals, industries, communities, and public and private agencies generally.

Field work covered less than 10,000,000 acres this fiscal year. The total area covered to date is 287,000,000 acres. That not yet covered is about 343,000,000 acres. The timber-supply phase so far completed includes 24 progress and final reports on 100 million acres, and forest-type maps for all or parts of 8 States. For the probable

forest-products requirements phase, investigations have been made and reports issued for nonfarm housing, furniture, mine timbers, and hardwood distillation.

Sweden and Finland, recognizing the tremendous importance of a reliable nation-wide forest inventory, are working on their second one. Field work is not yet 50 percent completed on our first one, and with inadequate regular appropriations, and emergency funds no longer available, field coverage is now nearly at a standstill. Progress in analysis and interpretation is too slow. It is increasingly difficult to keep up with requests for information from public and private agencies.

Forest management and economics.—Studies continue to furnish information as to the practicability of more conservative partial-cutting methods in the southern pine, ponderosa pine, and under some conditions in the Douglas fir regions. These studies have stimulated a definite development of improved methods of forest management. This will help stabilize local industries. Cutting which removes two-thirds of all merchantable trees in Lakes States northern hardwood stands brings an annual increment of 150 to 200 board feet per acre over a period of years. Light selection cuttings that remove only about one-third of the merchantable volume of the stand bring 240 board feet per acre. Average annual income from farm woodlands can be increased from one-third to one-half through better cutting practices and marketing, according to preliminary studies in Wisconsin and New York.

Studies in Arizona indicate that lighter cutting than has been practiced on most private forest lands is economically feasible and silviculturally advantageous there. Investigations in southern forests show that selective management of second-growth shortleaf and loblolly pine is profitable. General adoption of it should help satisfy southern requirements for pulpwood and saw timber, help keep forests productive, and help stabilize industries and communities dependent on them.

Accurate growth prediction is essential to sustained-yield management of forests since it provides the basis for determining the volume and kind of material that can be cut over any period of time without depleting the growing stock. At the same time it is one of the most perplexing problems facing forest managers, for growth varies widely with the class of timber, density of the stands, and the extent and nature of the mortality. In the Lakes States a growth formula has been developed that makes possible a more accurate prediction of increment for 20 years in advance. It is anticipated that through the application of this formula, cuts can be so regulated as to permit continuous operation of forest properties and greatly increased future growth.

Improved methods of gaging watering needs have saved \$3 per month in one large nursery, and refinements in specifications for nursery stock have increased survival of field-planted trees by as much as 50 percent in the Lakes States. The rate of spread of fire in southern coastal plain forests has been determined. This aids fire suppression there. Stumpage prices paid from early times up to and including 1934 for privately owned timber have been compiled, analyzed, and published. So have stumpage and log prices for 1937. Experiments to propagate and develop tree strains with better qualities continue at experimental stations in California and the Northeast. More than 50 promising poplar hybrids are being tested out in many regions. Promising hybrids have been obtained with maple, birch, oak, basswood, and yellow poplar.

Forest products, uses, markets.—The prefabricated plywood panel system for building houses has been proved technically sound and practical for one- and two-story structures with flat and sloping roofs. Arches, beams, rafters, and other large-dimension members made by gluing together small boards were first developed and demonstrated experimentally in the United States in 1935. This method is now used commercially in such structures as barns, auditoriums, and ornamental churches.

Substitution of chemical for mechanical seasoning of heavy timbers has proved practical in initial tests under commercial conditions, and wood is again on an equivalent technical basis with other materials for use as walking beams for oil derricks, for example. Next to cellulose, lignin is the largest chemical constituent of wood. Certain methods to convert it into new and useful products have been developed, and in the initial stages they are being applied commercially. By incorporating lignin with the negative plate, it has been found that storage batteries maintain maximum power in zero weather four times as long as they formerly could. To help consumers select the right species and qualities for their specific requirements, and to help overcome certain marketing difficulties, studies are being made of the working qualities of hardwoods in the southern, New England, and Appalachian regions. The tire-tube method of treating fence posts against decay—zinc chloride put in a discarded inner tube and attached to the butt end of the freshly cut post—has proved simple and inexpensive in actual use. Application of the semichemical process to blackjack oak and red gum resulted in high-yield pulps which were readily converted to high-quality corrugated stock.

Range management.—Many national-forest ranges furnish lush summer forage. Seasonal development of forage plants on these mountain ranges varies as much as 20 to 100 days from one year to another. When snow disappears early, range plants develop early,

and vice versa. But the length of the period of development ordinarily remains constant. This relationship makes it possible to predict with reasonable accuracy the date when ranges will be ready for grazing each year. Best results are obtained when, if a uniform opening date for the grazing season is established, that date is set 5 to 10 days later than the average date of range readiness over a series of years.

Too close and too frequent grazing of perennial forage plants on mountain ranges literally starves the plants, but reasonable grazing is not detrimental to them. Experiments conducted at the Intermountain station indicate the need for relatively light grazing (1) during the intense reproductive period when foods are used in the growth processes as rapidly as manufactured, and (2) after seed maturity when food storage is taking place. They also indicate that grazing should not be too close or too frequent during the spring and summer when the plant is manufacturing its food for current growth.

Below national forests are foothills and valleys which furnish spring and fall forage for livestock. Research at the United States Sheep Experiment Station in Idaho, in cooperation with the Bureau of Animal Industry, shows that body weights of sheep fluctuate directly with the amount of forage available on spring and fall range; that short forage supply during these periods means poorer condition of the herd and fewer lambs.

Indications are that sagebrush-bunch grass range in the Snake River plains of Idaho can provide its maximum share of forage when grazed in the spring and the fall under a rotation system. Different parts of the range should be grazed first in different years, starting when grasses are 2 inches high. Only a third of the available bunch-grass growth on the range should be grazed in the spring. Another one-third should be grazed in the fall, after the sheep return from summer grazing on higher ranges. The remaining one-third of the grass growth should be left ungrazed to assure sustained vigorous production by the plants the following spring. Such range use furnishes green forage during the spring lambing period, and adequate forage during the fall breeding season. It also reduces costly supplemental feeding during these periods in drought years.

Seeding of slender wheatgrass, mountain brome, and smooth brome have increased the forage value from 6 to 10 times on depleted mountain slopes in central Utah where rainfall averages from 12 to 20 inches annually. In cooperation with other Federal and State agencies and local stockmen, the Western Range Survey completed plans to maintain range productivity and better range and livestock management for 107 counties, involving 55 million acres of range land. Regional committees representing all interests help focus attention on, and solve, current range problems.

The water resource.—Usable water is a necessity, but the quantity available fluctuates continually and inherently. Recognizing that the condition of watershed lands markedly affects yields of usable water, areas are being purchased by public and private agencies to protect supplies. Actual prices recently paid have ranged from \$16.50 to \$450 per acre. Results of forest-influences investigations have confirmed earlier observations on the effectiveness of vegetative cover in controlling soil erosion, increasing infiltration into subsurface supplies, and increasing the usability of surface flows. Under dense chaparral, only a negligible amount of overland flow occurred during the record California storm of March 1938. Later in the year, after the area had been burned, heavy surface washing occurred during a storm of normal intensity.

Most efforts to conserve and control the water resource have centered on lower reaches of streams and rivers in the past. Under the Flood Control Act of 1936, the War Department remains the national agency for downstream engineering. But the act recognizes the Department of Agriculture as the Federal agency to investigate and take measures for retarding and controlling run-off, water flow and soil erosion on watersheds.

Flood-control surveys.—Funds made available in the War Department Civil Appropriations Act, 1939, permitted expansion of the Department of Agriculture flood-control surveys authorized by the Flood Control Act of 1936. These surveys are carried on jointly by the Forest Service, Soil Conservation Service, and Bureau of Agricultural Economics. Eighty-nine preliminary examinations were completed and detailed surveys of 18 watersheds were conducted during the year. Many of the surveys were nearing completion June 30.

These surveys involve analyses of relations of present watershed conditions to floods and siltation, including detailed study of the amount, type, and distribution of flood and silt damages, their origins, and means of reduction or prevention. They require knowledge of geology, soils, methods of farming, condition of forest and range land, historical and social development, economy of specific areas, precipitation and run-off, and dependencies of populations. Programs and plans for corrective measures must take account of economic feasibility as determined by costs and benefits, and as limited by social and economic values at stake.

Such changes in land use and management as may be desirable or necessary to reduce damaging siltation and flood flows are related, in the program, to people of the uplands as well as the lowlands. Previous experience by the Forest Service in long-range resource and land use planning has helped in the work of these surveys. The surveys, in turn, have shown the need for certain modifications of acquisition programs and national-forest-management methods.

Officials of the Forest Service served as chairmen of the tribureau committees on 6 of the 18 surveys where forest problems have major importance. On the remaining 12, where the problems arise chiefly from agricultural use, the Soil Conservation Service has supplied the chairmen. These watershed surveys constitute trials of methods and procedures in a specific field that is new to the Forest Service and the Department. Experiences gained from them, which have blazed the trail in interbureau cooperation for land-use adjustments, will be invaluable in prosecuting flood-control and other action programs on nearly 400 additional watersheds already authorized for survey.

FOREST INDUSTRIES CONFERENCE

Primary purposes of the Forest Industries Conference, established in 1939 at the suggestion of the Forest Service, are (1) to maintain appropriate and effective relationships between forest industries and public agencies having to do with the forest resource, (2) to assure cooperative consideration of business problems common to forest industries and the forest resource, (3) to insure coordinated handling of such problems by the different agencies directly concerned.

This conference is a catalytic rather than a policy-making organization. For forest industries it has been approved by the National Lumber Manufacturers Association, the American Pulp and Paper Association, and the American Pulpwood Producers Association. Among Federal agencies approval has been registered by the Departments of Commerce, Agriculture, and Interior. Membership in the conference, which hopes to assist in solving forest-industry problems on a cooperative basis and help promote better practices on forest lands, consists of one representative from each of these associations and Departments.

PRAIRIE-STATES FORESTRY PROJECT

Through the use of emergency funds the Forest Service has continued this project, conceived by the President in 1934, within an area in which there are 200,000 farm families. In less than 5 years, and with an expenditure of Federal funds that has averaged less than \$1,665,000 each year, this project has planted about 11,000 miles of living barriers against scorching winds. Nearly 4,100 miles were planted this year. Farmers have made land available. Through material and labor for fencing, by land preparation, plowing, and cultivating, which extends over 3 to 5 years, and protecting trees from rodent damage, they bear at least 50 percent of the total cost of the project.

These tree barriers are about 100 feet wide. Many trees in the have grown from 4 to 8 feet each year, and some have reached feet in height. Since being planted these living barriers have reduced soil-moisture losses at critical times, checked wind erosion, protected cultivated crops, and made localities more attractive as better places in which to live. Now, well established, they also provide the basis—through carefully conducted thinning operations—for harvests of fence posts, rural telephone poles, and wood for fuel.

THE CIVILIAN CONSERVATION CORPS

The Civilian Conservation Corps was organized early in 1933. Its first camp, on the George Washington National Forest in Virginia, was occupied on April 5, 1933.

The number of C. C. C. camps in the States has varied. The average from April 1, 1933, to June 30, 1939, has been 1,803. The average number of enrollees in these camps has been 314,054. The average number of camps and of enrollees under general supervision of the Forest Service has been 954 and 164,991, respectively. Including enrollees in Alaska and Puerto Rico, where the camp system is not comparable to that in the States, general supervision by the Forest Service has extended to an average of 167,000 C. C. C. enrollees per year. The total for 6½ years, including reenrollments, probably exceeds 2,150,000.

Forest Service supervision has entailed a fourfold responsibility: (1) Planning constructive, worth-while projects and supervising the work on them; (2) helping rebuild the boys and men physically, mentally, and spiritually; (3) helping train them so they may get and hold worth-while jobs in private employ; and (4) guarding their safety.

One of the qualities required of C. C. C. supervisory personnel is that its members shall have ability to train enrollees. Ninety-four percent of this personnel in camps for which the Forest Service is responsible give on-the-job training to C. C. C. enrollees, and 88 percent give of their own time to off-the-job training. This has helped enrollees find jobs and hold them, according to Robert Fehner, Director of the Civilian Conservation Corps, who reports that more than 515,000 enrollees left camps prior to completion of their enrollment to accept private jobs between April 1933 and July 31, 1939.

Since January 1936, there has been a planned safety program in all C. C. C. camps. Its effect in Forest Service camps is indicated by the rate of lost-time accidents and fatalities per 1,000 enrollees. This rate dropped from 10.0 in January 1936 to 3.03 in May 1939.

fighting forest fires is as dangerous as well as a difficult job. One of the most important parts of the safety program is training for it. Advance training is given to every enrollee who might conceivably be called on to take part in fire fighting.

Long-range plans for protecting, developing, and using resources like timber, forage, and water, and such forest-land values as recreation, are essential parts of administering national forests. These plans—extended, brought up to date periodically, coordinated, and adapted to enrollees and administrative requirements of their organization—have formed bases for C. C. C. work projects on national forests. Similar plans have been developed for all camps working on State forests, on Tennessee Valley Authority projects, and on private forest land. The Forest Service is also responsible for the work of these camps.

On private forest land C. C. C. projects have been confined, for the most part, to those essential to protection against fire, and against insects and diseases (p. 4). These projects include building and maintaining roads and trails, bridges, telephone lines, lookout houses and towers, supply and storage buildings, and firebreaks. Fire-hazard reduction along roads and trails is also a private-land project, as is work in preventing fires and in fighting them.

On publicly owned forest land a wider field is covered. The following national-forest projects are indicative of it. Figures used cover approximately 6½ years.

Planting.—C. C. C. enrollees have planted 823,102,000 young trees on 914,560 acres of national-forest land that have been burned, or that were too heavily cut by private owners before they became public property. Current estimates indicate that there are 3,600,000 acres still in need of planting.

Fire protection.—Fire protection is perhaps the most important contribution made by the C. C. C. On national forests it includes construction of more than 42,777 miles of roads and trails, 1,800 lookout structures, and 26,942 miles of telephone line, in addition to maintenance on these and other projects. It also includes 2,588,330 man-days in presuppression and fire-prevention work, and 2,037,000 man-days in fire fighting. These, with maintenance and a certain amount of new construction, are ever-recurring jobs.

Wildlife restoration.—Enrollees have improved and developed wildlife refuges; worked on game censuses; planted wildlife food; captured big game and transported it to understocked areas; built fish hatcheries and rearing pools, and stocked thousands of streams and lakes with millions of young fish.

Range management.—National forests furnish summer feed for domestic livestock (p. 42). Heavy concentrations of ground squirrels,

prairie dogs, pocket gophers, porcupines, and rabbits damage the range resource, on which big game also depends. Under the immediate direction of the Bureau of Biological Survey, C. C. C. enrollees have helped control rodents on some 6,896,480 acres in national forests. They have covered 90,380 national-forest acres in efforts to eliminate plants and shrubs that are poisonous to domestic livestock. And they have developed springs and water holes, constructed corrals, and built and maintained pasture and drift fences. These activities help secure better range management.

A complete list of accomplishments by enrollees is included in annual reports of the Director of the Civilian Conservation Corps, now a part of the Federal Security Agency.

THE HONOR ROLL

On March 22, 1939, the first three awards for heroism in fighting fires were made by the American Forest Fire Foundation. District Ranger Urban J. Post, of the Big Horn National Forest, was presented to receive his medal. One was awarded posthumously to Junior Forester Paul E. Tyrrell, of Oakland, Calif. Presentation of the award to Bert Sullivan, a fire-control cooperater of Cody, Wyo., was announced, and was made later in a ceremony at Cody. These awards were for heroism in fighting the Blackwater fire on the Shoshone National Forest in August 1937. Deaths from that fire were recorded in the 1938 annual report.

The 1939 honor roll includes 13 men. Despite the training referred to on page 28, 10 of the men who died were members of the C. C. C.

Seven enrollees and one foreman from camp S-132 lost their lives on the Pepper Run fire near Emporium, Pa. This fire occurred on October 19, 1938, and Squad Foreman G. Mahoney and Enrollees B. Bogush, A. Stephanic, J. F. Boring, H. F. May, S. Jocoisky, G. Vogel, and R. Hollabaugh were trapped by a sudden shift of wind. The five first mentioned died immediately. The last three died later of injuries received at the fire.

John B. Jones, enrollee of C. C. C. Company 1998, and John Thompson, enrollee of Company 2930, lost their lives on the Swamp Creek fire, Cabinet National Forest, Mont., and the Le Clerc fire, Kaniksu National Forest, Mont., respectively. Thomas E. Grubb, an Emergency Relief Administration tank-truck driver, was killed in a collision between his truck and a private automobile in southern California. Ernest L. Emory and Clyde T. Hamilton died of bronchial pneumonia after fighting the Cedar Camp fire on the Siskiyou National Forest in Oregon.

REPORT TO THE JOINT COMMITTEE ON FORESTRY

In the President's message¹ of March 14, 1938, to Congress, he recommended appointment of a committee to study the forest situation. "I hope," he said, "these studies * * * will form the basis for essential legislation during the next session of Congress * * *." He suggested that "particular consideration might * * * be given * * * to the situation with respect to private forest lands, * * *." And he stated that—

Facilities of those technical agencies that, in the executive branches of the Government, deal with the many phases of our forest problem will, of course, be available to such committee as the Congress may appoint. These technical agencies will be glad to assist the committee in assembling and interpreting facts, indicating what has been done, what still needs to be done, and in such other ways as the committee may desire.

Congress appointed what is known as the Joint Committee on Forestry.² Time originally set for it to investigate and report has been extended³ to April 1, 1940. The committee has held public hearings, and plans to hold more. In an effort to be helpful the Forest Service has prepared a report in preliminary form. A large group of Forest Service field and office personnel helped collect and interpret the data in it. Suggestions with respect to legislation, appropriations, and action programs have been included. Advance copies have been sent to many outstanding individuals and to representatives of such typical associations and groups as: American Farm Bureau Federation, American Federation of Labor, American Forestry Association, American Furpentine Farmers Association, Association of State Foresters, Babson Institute, Carnegie Institution, Congress of Industrial Organizations, Farmers Union, Izaak Walton League, National Grange, National Lumber Manufacturers Association, Society of American Foresters, National Wildlife Federation, and the United States Pulp Producers Association.

Individuals, groups, and associations have been asked to criticize and comment on the report as prepared. Conferences have been held, and others are planned. These conferences, criticisms, and suggestions will be helpful in putting the report in final shape for transmittal to the Joint Committee on Forestry.

RECREATION

Timber and minerals, grass and forage, game and water are tangible forest crops. Definite values can be put on them. Certain values of

¹ Doc. No. 539, 75th Cong., 3d sess.

² S. Con. Res. No. 31, 76th Cong., 1st sess.

³ H. Con. Res. No. 11, 76th Cong., 1st sess.

recreation defy price analyses. But they are real values just the same for they help change for the better the spirit of a country's people.

Forest recreation has become a downright necessity for great numbers who may not be able to buy a change of air by sending the family to a resort for the hot season. Recognizing this public need, the Forest Service has summarized experiences of many of the 32¾ million Americans who discovered the national forests as a natural retreat and playground last year. Summarizing also its own experiences in coordinating recreational and other uses of national-forest resources, a publication about outdoor recreation with particular reference to national forests is being prepared.

Written in popular style for the layman, this publication outlines opportunities and demands for outdoor rest and change on national forests in Alaska, Puerto Rico, and in 36 States. It shows how recreation is coordinated and interrelated with other national-forest uses. It indicates some of the effects of mass outings on local economy. It suggests ways and means of providing a more equitable distribution of forest outings to the underprivileged and low-income groups. And it has helped the Forest Service restate old and establish new policies and procedure with respect to management of recreation on the national forests.

INTERDEPARTMENTAL COMMITTEE

During the year a committee representing the Departments of Interior and Agriculture has been established. It consists of two members from each Department—one representing the Secretary of the Interior, one the Secretary of Agriculture—and one member each from the National Park Service and the Forest Service. Its purpose is to facilitate consideration of policy and administrative matters of mutual interest.

Through this interdepartmental committee agreement was reached during the year with respect to reports made to the Congress and the Bureau of the Budget on more than 30 separate legislative proposals. Agreement was also reached on proposals to transfer certain national-forest areas to (1) the Rocky Mountain National Park in Colorado, and (2) the Glacier Bay National Monument in Alaska.

NORTHERN PACIFIC LAND-GRANT SUIT

The Northern Pacific land-grant suit involves the claim of the Northern Pacific Railway Co. for damages because it was denied the right to select 2,800,000 acres of land within its indemnity limits in Wyoming, Montana, Idaho, and Washington.

The Federal court for the Eastern District of Washington has now rendered its decision with respect to points of law involved. Certain

of these points were decided in favor of the company, and certain of them were decided against it. An appeal directly to the Supreme Court of the United States, as authorized by special statute, was deferred pending decision in a separate suit instituted by certain minority stockholders in the railroad, but was perfected before the close of the year. Expectations are that it will be argued before the full term of the Supreme Court. Meanwhile, the Forest Service cooperated actively with attorneys of the Department of Justice in assembling data necessary for presentation of the Government's case.

LAND-USE PLANNING

Problems of land use and economy have multiplied in number and increased in vital social significance. Comparable increases have occurred in the number of public, semipublic, and nonpublic agencies set up to study such problems, and to plan and execute measures to solve them. A member of the Chief's staff has been designated to assume primary leadership of land-planning activities within the Forest Service, and to correlate efforts in land planning with those of other bureaus of the Department and other Federal, State, and local agencies. This staff member will be assisted by the Division of Forest Land Planning, which hitherto has been designated as the Division of National Forest Planning and Establishment.

The National Forests

THE Forest Service has had jurisdiction over the national forests since February 1, 1905.

On June 30, 1939, there were 2 national forests in Alaska, 1 in Puerto Rico, and 155 in 36 States. There were also national forest purchase units in 4 other States. The total area within exterior boundaries of national forests and purchase units is 227,560,937 acres. Of this, 175,843,405 acres were owned or in course of acquisition by the United States, while 51,717,532 acres were in State or private ownership. Of the Federal lands, 17,023,200 acres have been purchased under the Weeks Law. The remainder was reserved from the public domain or acquired through exchange, donation, or transfer. Tables giving gross and net areas of each national forest, by States, and other information, are included in section Z of volume X, Administrative Statistics. This section (p. 48), or any of the individual tables in it, will be mailed on request.

ADDITIONS AND ELIMINATIONS

The national-forest system is not static. Forest land in private ownership is acquired in the public interest for additions through exchange, purchase, and donation. Suitable public domain and other Federal land is added and eliminated through transfers and boundary adjustments.

Additions by exchange.—The procedure of additions by exchange is applied to private forest land within national forests. In some instances it is also applied outside but adjacent to them. Its object is to simplify national-forest administration and reduce costs of protection.

There were 103 exchanges completed during the year. They conveyed to the United States 209,143 acres, valued at \$670,007. The Federal Government gave, in lieu, 104,480 acres valued at \$360,299 and 96,128,000 board feet of stumpage valued at \$271,391. Net gain in national-forest area by these transactions was 104,663 acres. Besides these exchange transactions, 145 others were approved by the Secretary of Agriculture, and referred by him to the Secretary of the Interior or to the National Forest Reservation Commission. They had not been completed by the end of the fiscal year.

One important exchange completed was in the Delta purchase unit, Mississippi. Here 40,857 acres containing 77,020,000 board feet of commercial timber were offered the Government in exchange for \$404,111 worth of national-forest stumpage. In another exchange, on the Modoc and Shasta National Forests, Calif., the Government was offered 71,017 acres supporting 340,065,000 feet of timber for an equal volume of national-forest stumpage.

Additions by purchase.—No emergency funds were allotted for purchase of forest land for national forests during the fiscal year 1939, and the regular appropriation bill carried only \$3,000,000 for this purpose. At three meetings the National Forest Reservation Commission approved for purchase 521,939 acres for a total of \$2,158,405, and obligated the balance of the appropriation. Purchases with Uinta-Wasatch receipts, in Utah, were 16,381 acres for a total cost of \$47,541. Included in approved purchases were (1) 11,265 acres tributary to Bend, Oreg., to help put forests on which four-fifths of its people depend on a continuous-yield basis; (2) 6,251 acres in the coast redwood belt, California, including some virgin timber; (3) 13,394 acres that, in the Jefferson National Forest, in Virginia and Kentucky, include the famous Breaks of Sandy.

Area vested in Federal ownership through final payment during the year aggregated 697,179 acres. The aggregate area acquired by

purchase to June 30, 1939, is 16,369,751 acres. Of this 11,837,053 acres have been acquired since June 1933.

Additions through donations.—During the year 40 tracts embracing 39,881 acres were donated and accepted by the Secretary. The total donated to June 30, 1939, including administrative sites, is 337,388 acres.

Additions by transfer.—To facilitate economy in administration the President approved transfer of 262,379 acres, formerly managed by the Resettlement Administration and its successors, to national-forest status during the fiscal year 1938. During the same year the Secretary of Agriculture assigned 314,980 acres to the Forest Service for protection and management. This year the President approved transfer of 122,972 acres, including the Magazine Mountain project to the Ouachita National Forest, and the northeast Georgia project to the Chattahoochee National Forest. The Secretary also assigned 35,124 additional acres to the Forest Service for protection and management, pending action to give these lands national-forest status.

Additions and eliminations by boundary adjustments.—Progress of purchase and exchange programs requires constant shaping and reshaping of national-forest boundaries to provide effective and economical administration. This, in brief, was the basic reason for 49 bills covering 36 specific boundary adjustments introduced in Congress last fiscal year.

Proclamations or Executive orders formalized the following changes during the year: The Manistee National Forest was established, in Michigan, from lands previously acquired by purchase. The Lemhi National Forest, Idaho, was abolished, but the lands were transferred to the Challis and Salmon National Forests in Idaho. Under authority granted the President by Congress, 411,813 acres, of which 33,586 acres were public domain, were added to the Deschutes National Forest, Oreg. The President also added 392,686 acres, including 6,710 acres of public domain, to the Cache National Forest in Utah. He transferred 505,600 acres from the Tongass National Forest to the Glacier Bay National Monument, Alaska.

The National Forest Reservation Commission approved many adjustments and changes in purchase units without either adding to or subtracting from national-forest acreage. Additions to national forests by boundary adjustments grossed 957,067 acres during the year. There was one elimination—the 505,600 acres mentioned above.

Protecting the National Forests

FORESTS in State and private ownership must be protected from fires and from insects and diseases (p. 4). So must the national forests; for fire, insects, and diseases damage and destroy their resources on which people depend for their livelihoods, and accelerate erosion and floods. Scarring and marring the landscape fires, pests, and diseases also destroy beauty; make it impossible for people to find peace or inspiration in forests or to enjoy recreation there.

PROTECTION FROM FIRE

The need for protecting national forests from fire is indicated by the fact that during the calendar year 1938 one series of 3-day electrical storms in northern California and southern Oregon, unaccompanied by rain, set 60 and 150 fires on the Siskiyou and Klamath National Forests, respectively. The need is emphasized by the fact that although skilled leaders were promptly assembled from two States, and advanced forms of organization and technique were used, including prompt delivery to fire camps by aircraft and parachutes of 112 tons of supplies and equipment, the Cedar Camp lightning fire on the Siskiyou National Forest burned 34,000 acres and had to be fought for 26 consecutive days in rough and rugged terrain before it was brought under control.

This was the largest national-forest fire in 1938, but it was only 1 of 5,702 that were set by lightning and 7,838 that were man-caused. All but 73 of these fires were held to less than 300 acres in size, but the 13,540 fires burned 219,000 acres. Of this area, 175,000 acres are in Federal ownership. Damage to tangible Federal values by these fires was estimated at \$476,354. Including the appraised value of work done by C. C. C. and E. R. A. units, expenditures for fire fighting were \$2,587,041.

Fire prevention and cooperation.—In 1938 the American Association for the Advancement of Science organized an advisory council on human relations. It is cooperating on fire-prevention problems, particularly those having to do with man-caused fires. Detailed psychosocial studies were carried out by the Forest Service in the search for more effective ways of reaching the attitudes and habit patterns of people who start fires intentionally or carelessly. Planned educational campaigns in cooperation with newspapers, radio-broadcasting systems, motion-picture theaters, and civic and other organizations, were continued and intensified.

Fire suppression.—On national forests in 1938 there were 232 more lightning fires and 1,643 more man-caused fires than in 1937.

There were 102,671 more acres burned. Damage to tangible values was \$324,970 greater. Fire-fighting expenditures exceeded those of 1937 by \$1,359,917, and there were 11 more fires that got bigger than 300 acres. By comparison with 1937, the 1938 record was unfavorable. So were weather conditions, including an unusually bad concentration of dry lightning storms. But 1938 emphasized the fact that although methods of rating fire danger and discovering and extinguishing small fires are relatively well advanced, prevention of man-caused fires and suppression of large ones lag.

These are now the weakest links in the chain of effective fire control. Suddenly to recruit several thousand men at labor centers, and to transport, organize, and manage them effectively on a fire, is like attempting to repel an unexpected armed invasion with the aid of a limited force of trained personnel. It is, of course, impracticable to maintain trained men in numbers adequate to combat all the fires that may escape from regular fire-control forces at unpredictable times and places. But there is urgent need for financial resources that will permit a longer period of employment—it is now only about 4½ months each year—for fireguards, who are the backbone of trained fire-fighting personnel.

Search for more effective ways of combating the occasional fire that gets away is being made. One experimental 40-man special crew has been organized. Under trained leadership this crew will attack all larger fires within striking distance of its base camp in southwestern Oregon. Experiments will be continued with (1) delivery of food to men on fire lines, (2) developing methods of organizing workers for fast construction of successful fire lines, and (3) dropping men by parachute to inaccessible fires before they get large.

Since the New England hurricane of last September (p. 19), there are thousands of acres of bad blow-down on the White Mountain National Forest, in New Hampshire, through which it may take a man an hour to worm his way a quarter of a mile. Hazard-reduction work has been done there. Because of widespread timber-salvage work, skilled woodsmen are available in larger numbers than usual. But there is grave danger that fires may escape and make devastating runs before they are finally corralled. To help meet this situation hazard-reduction crews are bunched for test runs, and methods of control-line construction, modified to meet eastern conditions, have been adopted.

PROTECTION FROM INSECTS AND DISEASES

Serious epidemic infestations of tree-killing bark beetles were experienced during the year in national forests in Idaho, Montana, Colorado, Wyoming, and Utah. Lesser attacks were recorded in

other Western States. No extraordinary infestations occurred on national forests in the Lakes States, the East, or the South.

Measures were successful in reducing major epidemics, but as is normally the case, additional work will be needed on many areas. During the year, 624,937 acres were covered in insect-control work. This involved treatment of more than 86,000 trees. Excellent cooperation was given by the Bureau of Entomology and Plant Quarantine. Close working relationships with this Bureau in connection with both insect control and white pine blister rust control are in large measure responsible for results obtained.

Progress was made in the war on white pine blister rust. Chief theaters of action were again in northern Idaho, eastern Washington, and the California-Oregon sugar pine region. The year's work brought the total area which has been given initial treatment to 2,288,251 acres, but 1,522,467 acres of susceptible-pine timberlands, in the path of the disease, have not been touched. The rust is established in this area, and is killing young pines that should form the basis for future commercial timber crops. Repeat treatments must be made on many areas if initial control investments, and future forests, are to be safeguarded. Work of this character has covered 342,309 acres.

C. C. C. and W. P. A. crews are used in insect- and disease-control projects to the limit of their availability. The war on the serious blister rust threat to future timber supplies in Montana, Idaho, Washington, Oregon, California, must be fought in inaccessible country, during the short summer season. Mobilization and use of emergency labor is inadequate. It is supplemented by crews of local men paid from regular funds. But like epidemics among human beings, white pine blister rust spreads rapidly. It must be hit hard, and without a let-up, if adequate control is to be assured.

Development and Administration

BESIDES protecting the national forests from fires, insects, and diseases, Forest Service stewardship involves developing and administering these properties—including their land, water, timber, forage, wildlife, and recreational resources and the services they perform—in the public welfare. Progress is summarized in the following pages.

LAND

Among processes which through land management are essential to planned and correlated resource use, are:

Surveys and maps.—The Forest Service uses two methods to secure map data for national-forest areas for which it is not yet

available. One is aerial photography. The other is topographic and drainage surveys. The former was used to cover 14,417 square miles, and the latter to cover 7,961 square miles during the year. Forest Service mapping conforms to standards of the Federal Board of Geographical Names, and is integrated with the work and programs of that Board.

Highways, roads, trails, landing fields.—Besides emergency landing fields, the national-forest transportation system as now planned includes 24,817 miles of forest highways, 114,743 miles of forest-development roads, and 154,791 miles of horse and foot trails. Including progress made during the year, percentages completed to satisfactory standards are 50, 45, and 71, respectively. In country accessible to roads there were 66 emergency landing fields ready for use by the end of the year. Funds allotted for construction and maintenance of highways, development roads, and trails, by States, are included in section Z of volume X, Administrative Statistics (p. 48).

Settlements, claims, special uses.—There were 43,031 active special-use permits for small areas of national-forest land as of June 30, 1939. They were issued for such purposes as summer homes, pastures for domestic stock, drift fences, roads, resorts, and the like. Rental was charged on 23,411 of them, and 19,620 were issued free. Special-use receipts for the year totaled \$365,025.95.

Final applications for homestead patents during the year totaled 102. Favorable reports were issued by the Forest Service on 63, and unfavorable reports on 16 of them. Of the 100 final applications for mineral patents to national-forest lands, 74 were reported upon favorably and 26 unfavorably by the Forest Service.

WATER

Water is a necessity for domestic purposes, for irrigation, and for power. Uncontrolled at its sources, it causes erosion and floods. They are recurring national menaces.

We need man-made structures of concrete, steel, and earth to confine and regulate angry waters. We also need to supplement them with land-management measures that hold water back from rivers by conditioning soil so it will absorb more rainfall.

Porous forest soils (p. 17) do this. That is one reason why national forests were established on headwaters of most major streams west of the Great Plains; why additional national forests have been created in the East on watersheds of many navigable streams and at many sources of supply for water used for power and for domestic purposes. General Forest Service activities with respect to the water resource and flood control have been described briefly. So have efforts to pre-

serve forest and vegetative cover on national forests by protecting them from fire, insects, and diseases. Methods used to help prevent erosion and floods by regulating timber-cutting and grazing domestic livestock, and by planting, will be found on pages 39 and 42. Action on a departmentally coordinated watershed flood-control program has not as yet been initiated but \$29,000 from the Department's flood-control funds has been authorized to meet emergency on 11,000 acres denuded by forest fires on steep headwaters of the Santa Ana and San Gabriel Rivers in southern California. This denudation set the stage for calamitous floods in the populous valleys. Emergency treatments, including sowing of mustard, channel rectification, and minor engineering stabilization work have been undertaken to help prevent damaging run-off, slides, and mud-rock flows.

Authority to issue licenses or permits for operation of electric power distribution lines in national forests now rests with the Federal Power Commission. There are, however, 162 active permits and easements issued by the Forest Service prior to the passage of the Federal Water Power Act. Of these there are 85 for power-generation projects with a combined estimated average low-flow output of 331,991 horsepower and a combined estimated installed capacity of 678,537 horsepower. There are also 77 permits for transmission-line projects with a length of 703.4 miles within national-forest boundaries. During the year annual rental fees were charged on 52 power projects (estimated low-flow output 316,344 horsepower) and 6 transmission-line projects (length, 636.3 miles). No rental fees were required on 33 power projects (estimated low-flow output, 15,644 horsepower) or on 10 transmission-line projects (length, 67.1 miles).

In assisting the Federal Power Commission in administering the Federal Power Act, the Forest Service at the end of the fiscal year was supervising the operation of 428 permits and licenses. Of the total applications received by the Federal Power Commission from all sources during the year, 80 percent, or a total of 81, involved the use of national-forest land.

TIMBER

There are 175,843,405 acres of Federal land in the national forests. In round figures this includes 134 million acres of forest land and approximately 41 million acres of intermingled grass, browse, and alpine country. Of the forest land, also in round figures, 88 million acres are capable of producing commercial timber under present or reasonably conceivable future conditions. But estimates indicate that only about one-third of the saw timber now in national forests

ould be logged at a profit under present operating and marketing conditions.

In part because of the urge for quick liquidation, more than 95 percent of the forest products produced in the United States each year comes from privately owned forest lands. Since less than 5 percent comes from national forests, cutting operations on them are confined to a relatively small part of their accessible commercial forest land. There are as yet only 3.4 million acres under intensive sustained-yield forest management in the national forests, with 33.3 million acres under extensive sustained-yield management. Plans have been prepared for additional areas, and management will be extended as rapidly as additional cutting is economically feasible.

Timber sold and harvested.—Sales of national-forest timber are encouraged where woods and mills operations will help support local and dependent families and communities, and where regulated cutting will increase the growth and quality of the remaining stand. Large sales are made under this policy, but most sales are relatively small.

There were 22,717 national-forest timber sales made during the fiscal year. Stumpage involved in them was equivalent to 1,842,12,000 feet b. m. The net volume involved in exchanges (p. 34) was equivalent to 418,251,000 feet b. m.

Timber actually cut under sales and under land exchanges was equivalent to 1,017,269,000 and 273,292,000 feet b. m., respectively. Receipts collected for sales of timber, forest products, and as settlement for timber trespasses, were \$2,857,211. Timber worth \$690,636 was delivered in exchange operations. It is estimated that the equivalent of 269,233,000 feet of timber was given away. This includes head and down trees customarily granted free to local settlers for personal use.

Planting.—During the calendar year 1937 the Forest Service operated 26 national-forest nurseries. In 1938 it operated 27. In 1937 the nurseries furnished 136,809,000 trees. They were used to plant 55,744 national-forest acres, and to supply other Federal agencies and States with 10,357,000 trees. During 1938 the nurseries furnished 39,218,000 trees. They were used to plant 154,993 acres in the national forests, and supplied 7,008,000 trees to other Federal agencies and (p. 13) States.

On December 31, 1938, there were 814,867 acres of plantations on national forest lands. The total acreage planted in 28 years, including replantings, is 1,082,348, or an annual average of 38,655 acres. Despite the large amount of work done in recent years by the C. C. C. (p. 29) there are in the national forests 3,600,000 acres that must be planted if they are to be made productive again. At the average rate of progress, this will take 96 years.

FORAGE

Four and a half million acres of crop-producing lands and million acres of range lands in private ownership, representing livestock and ranch investments of around \$200,000,000, are definite related to and dependent upon national-forest grazing resources Western States. Eighty million acres in national forests are used by domestic livestock.

Permits and numbers of stock.—On the national forests, in the calendar year 1938, there were grazed under pay permits 1,220,500 cattle, 29,543 horses, and 126 swine belonging to 19,006 owners; and 5,300,140 sheep and 7,160 goats belonging to 5,478 owners. The number of permittees was 3 percent lower than in 1937, and there were 3 percent fewer stock, but there was an increase over 1937 of 3 percent of the cattle and 5 percent of the sheep grazed under temporary permits.

In addition, 39,105 cattle, 44,661 horses, 16,349 swine, 10,586 sheep and 4,833 goats used national-forest ranges under the regulation authorizing free grazing permits for the few livestock in actual use by prospectors, campers, and travelers, those used in connection with permitted operations on national forests, and not more than 10 head of milk or work animals used by any one person for domestic purposes.

Reductions, trespasses, losses.—Reductions for range protection in western national forests totaled 8,818 cattle and horses, and 28,477 sheep and goats in 1938. Reductions for distribution totaled 477 cattle and horses and 2,675 sheep and goats. There were 11,677 cattle, 50,497 sheep, and an estimated 3,000 horses in trespass on western national forests at one time or another during the year.

Livestock losses due to poisonous plants, predatory animals, disease, and other causes totaled 15,827 cattle and 149,183 sheep. This was less than the previous 5-year average. Poisonous plants were the greatest single cause of cattle losses. Predatory animals accounted for the major part of the sheep losses.

Rodent control.—Rodent-control work under the cooperative direction of the Bureau of Biological Survey was done on 788,700 acres during 1938. A large acreage is still badly infested. Follow-up work is an essential factor in effective controls.

Grazing fees, limits.—For 1939, based on 1938 market prices, grazing fees average 11 percent lower for cattle and 22 percent lower for sheep than the 1938 fees. Tentative policy regarding limits was discussed with a joint committee of the two national livestock associations in July 1938. Out of this and subsequent meetings throughout the West came regional recommendations which were correlated in the Washington office. Although the limits approved

to not attain complete uniformity, with minor exceptions they were supported by a strong majority vote of the stockmen concerned.

Local livestock associations.—There was mutually helpful cooperation with 768 local livestock associations during 1938. All of them elect their own officers. Officers and associations are independent of the Forest Service, but to facilitate cooperation 729 associations—an increase of 10 over 1937—qualified for recognition under advisory-board regulations. Cooperation through local stock associations deals largely with current management on individual ranges used by member permittees.

Range surveys.—Some 3,835,015 acres were covered by intensive range surveys during the calendar year 1938. Of this, 1,473,673 acres were done by aerial surveys. This brings the total aerial surveys to date to 7,837,752 acres and the grand total of intensive surveys by all methods to more than 50,000,000 acres. In addition, extensive surveys totaling 17,972,000 acres had been recorded by the close of 1938. Acreage in extensive surveys is dropped from the records as coverage of the same areas is made by more accurate intensive methods.

Range management, and A. A. A. range-conservation program.—A committee of range specialists revised instructions for preparation of range-management plans, which are now being tested in the field. A Forest Service range specialist, assigned to the A. A. A., continued technical supervision of the range-conservation program under the Soil Conservation and Domestic Allotment Act.

WILDLIFE

The national-forest wildlife resource may be summarized as follows:

Big game.—As of January 1, 1939, estimates placed the total number of big game at 1,841,000. This is an increase of 170 percent since 1924. Deer—there are 1,584,000 of them—are to be found on all the 158 national forests. There are 140,000 elk on 95 forests; 58,000 black bear on 134 forests; 18,300 mountain goats on 30; 18,100 antelope on 35; 10,100 bighorn sheep on 57; and 7,280 moose on 31. Alaska brown, and grizzly bear now number 5,190 on 28 national forests. The former are found on the 2 national forests in Alaska; the latter on 28 national forests.

Fur bearers.—Estimates indicate 2,340,000 fur bearers of miscellaneous species. They could be increased without major conflicts with other national-forest uses and values.

Birds.—An unestimated number of game, nongame, and insectivorous birds.

Fish.—There are approximately 70,000 miles of good trout streams and thousands of natural and artificial lakes and ponds suitable for

game fish in the national forests. Forest officers planted or supervise the planting of over 180 million fish in 1938. During the 6-year period 1933-38, 831,253,500 fish were planted by or under the supervision of forest officers. The C. C. C., State, and other agencies also planted many fish in national-forest waters.

Wildlife refuges and sanctuaries.—Within national forests there are 36,534,713 acres in 661 wildlife refuges and sanctuaries.

Wildlife values.—National-forest wildlife provided attractive hunting and fishing last year for some 4,249,000 people in the continental United States, and about 24,000 in Puerto Rico and Alaska. Positive annual wildlife values for national forests are estimated at more than \$100,000,000.

Wildlife management on the national forests recognizes recreational, esthetic, and educational, as well as economic values of this resource. It deals with such problems as those arising from grazing by domestic livestock, harvesting the timber crop, and needs for highways, roads, trails, and airplane landing fields to help protect forest and forage from damage and destruction by fire. It maintains cooperative relationships with the States, with such Federal agencies as the Biological Survey and the Bureau of Fisheries, and with sportsmen's associations, livestock organizations, nature societies, and educational and research institutions of various kinds.

With increases in herbivorous game, a number of problem areas have developed where available winter, early spring, and late fall ranges are not in balance with available summer ranges. The past year has recorded distinct accomplishments in the recognition of overstocking problems by States, sportsmen's associations, and other agencies. More game lovers and game officials have come to believe that wildlife in this twentieth century is a matter of management within available range limitations; that over the great bulk of its range, wild game as well as domestic stock must have human attention and control.

RECREATION

The national forests include 175,843,405 acres of public land. On the basis of a total population of 130 millions, each citizen's share is a little larger than a football gridiron. But the national forests belong to all the people, and the Forest Service is charged to administer all its resources and uses in such ways as will increase the wealth and happiness of the greatest number in the long run.

One use of this vast estate is for human recreation. Millions of people come to it, each year, for an hour or a day or a series of days of rest, of relaxation, of inspiration, of seclusion, or of sport. Among

These people are those who live in cities and never saw the wild before; others who live on the prairies and never heard the wind sigh through tall pine trees; still others who long for a change from their lives by the sea.

Among all these people, too, are those with ample and those with scant means; those who can afford mountain and forest hotels, resorts, and dude ranches; others who must plan long and carefully if wives and children are to find, once each year at community or free public campgrounds, relief from summer temperatures that at home may exceed 100° F. during the day and 90° at night.

The natural and the primitive.—National forests help protect the water resource and yield annual crops of timber and forage. But they also yield repose and joy. And since there are plenty of complex and clamorous amusements available to most people elsewhere, very effort is made to preserve a spacious and a natural air in developing national-forest recreational opportunities and facilities. The aim is to keep such facilities simple, inexpensive, and natural; as nearly as possible accessible to all, but with ample areas within which conditions of transportation and vegetation approaching the primitive are maintained.

Under this policy, development of such facilities and structures will aid in the enjoyment of those types of recreation appropriate to the forest is encouraged. And preference is given to developments that provide opportunities for participant rather than spectator enjoyment of recreation activities.

Variety.—There are in the national forests hot, dry woodlands of pinon and juniper, and alpine forests and meadows which during part of the year are saturated with the snow and rain and mist of mountain tops. There are abused, cut-over lands purchased by the Government to restore them to productivity, and virgin forests as untouched by commercial cutting as they were before the days of Columbus. In the Southeast and the Southwest and the Black Hills are forests so devoid of water bodies as to require artificial lakes and reservoirs. In northern Minnesota and Wisconsin there are forests with so many thousands of lakes that no one has ever counted them all. There are waterfalls, dry mesas, turbulent rivers, and merry little streams. There is timberland, range land, rock land, and desert land. There is an infinite variety of trees and shrubs and flowers, and millions of big game animals, fur bearers, and other wildlife.

This, in brief, is a picture of the national-forest estate within which more than 32¾ million visits were made by people who, from every State in the Union, sought and found rest, relaxation, and recreation here in 1938.

Appropriations, Expenditures Auditing

SINCE Forest Service responsibilities and activities extend beyond the national forests, so do funds allotted to and expended by it. For the fiscal year 1939 they include, for example, expenditures from appropriations and funds as follows: Cooperation with States and private agencies in fire control, planting, and forestry, \$2,153,327; contributions by States, counties, associations and individuals for fire control, slash disposal, improvement work, etc., \$2,097,842; for fire control in New England as a result of the hurricane there, \$471,198; work relief including C. C. C. expenditures for camps on State and private lands, for camps located on lands controlled by other Government agencies, and for national forest camps, \$35,050,476; research \$2,053,334; other Government agencies, \$665,229; and \$641,525 miscellaneous, including repayment of deposits. Expenditures for protection, management, development and extension of national forests were \$31,721,193. This included, in part \$8,354,603 for forest highways (expended by Public Road Administration), and \$2,732,237 for acquisition of additional forest lands from regular appropriations.

Funds to carry on Forest Service activities during the fiscal year were derived from 42 appropriations, and were grouped in six broad classes. Funds were allotted to units and subunits by appropriation objects or purposes. Each unit maintained accurate records by fund and by projects, purposes, and objects. Encumbrances and expenditures were confined to amounts and purposes authorized. Administrative controls and detailed budget and accounting records were maintained, and with independent auditing were extended to the 10 regional offices, 12 experiment stations, Forest Products Laboratory, Prairie States and New England projects, 155 forest offices, 78 ranger districts, 16 State C. C. C. offices, and numerous C. C. C. camps.

In addition to accounting and fund-control records, expenditures are broken down, without reference to appropriations, into 40 major cost-accounting captions. These reflect the actual use of appropriated funds in connection with individual resources. They, and cost records kept by projects, supply the cost data used in administration and that required by the Secretary, the Bureau of the Budget, Congress, and other agencies.

Total expenditures for all purposes by the Forest Service during the fiscal year were \$74,854,124. Receipts were \$4,903,376, of which \$1,215,925 was, under existing legislation, returned to the States.

New Legislation

THE first session of the Seventy-sixth Congress extended beyond June 30, which was the end of the fiscal year 1939. Legislation that, enacted during the entire session of this Congress, affects the Forest Service, includes:

APPROPRIATION ACTS

Department of Agriculture, act of June 30, 1939 (Public, No. 159), makes regular appropriations for fiscal year 1940.

First Deficiency Act of March 15, 1939 (Public, No. 7), includes \$500,000 for protection and management of the White Mountain National Forest, in New Hampshire and Maine, and \$5,000,000 for protective improvements, reduction of fire hazard, and prevention of fires on non-Federal lands (p. 20).

Second Deficiency Act of May 2, 1939 (Public, No. 61), includes \$2,480,000 for emergency fire fighting, fiscal year 1939.

Independent Offices Appropriation Act of March 16, 1939 (Public, No. 8), appropriates \$295,000,000 for the C. C. C. fiscal year 1940, of which approximately \$26,000,000 is to be allotted to the Forest Service.

Emergency Relief Act of February 4, 1939 (Public Res. No. 10); Emergency Relief Act of April 13, 1939 (Public Res. No. 10), appropriate \$725,000,000 and \$100,000,000, respectively, additional fiscal year 1939, of which \$2,005,768 project funds and \$135,000 administrative funds were allotted to the Forest Service. These amounts, added to previous allocations of emergency relief funds, brought the total allocations for the fiscal year 1939 to \$6,843,123 project and \$375,000 administrative funds.

Emergency Relief Act of June 30, 1939 (Public Res. No. 24), appropriates \$477,000,000, together with unexpended fiscal year 1939 balances, for fiscal year 1940, of which \$5,859,945 project funds and \$234,000 administrative funds are to be allotted to the Forest Service.

War Department Civil Appropriation Act of June 28, 1939 (Public, No. 154), includes \$133,000,000 for flood control, \$3,000,000 being for transfer to the Department of Agriculture, a portion of which will be expended by the Forest Service.

OTHER ACTS

Act of April 3, 1939 (Public, No. 19), to provide for reorganizing agencies of the Government.

Act of June 6, 1939 (Public Res. No. 19), authorizing the acceptance of certain lands on Government Island, Calif.

Act of June 13, 1939 (Public, No. 125), to amend the mining laws applicable to the watershed on the headwaters of the Bonito River, Lincoln National Forest, N. Mex.

Act of June 30, 1939 (Public, No. 163), to extend the time within which annual assessment work on mining claims may be commenced.

Act of July 20, 1939 (Public, No. 199), to authorize the creation of new national forests in Montana.

Act of July 27, 1939 (Public, No. 240), for the protection of the water supply of the city of Ketchikan, Alaska.

Act of August 7, 1939 (Public, No. 326), to amend the act establishing the Civilian Conservation Corps.

Act of August 10, 1939 (Public, No. 374), to include within the Kanab National Forest, Wash., certain lands owned or in the course of acquisition by the United States.

Act of August 11, 1939 (Public, No. 394), to authorize the addition of certain lands to the Wenatchee National Forest, Wash.

House Concurrent Resolution No. 11, March 31, 1939, continuing the Joint Committee on Forestry.

Administrative Statistics

THE practice of compiling certain basic statistical material in tabular form and making it available separately from the annual report, rather than as a part of it, was inaugurated in 1928. This practice made such material readily available for wider use and resulted in definite savings. It is, therefore, continued.

Section Z of volume X, Administrative Statistics, is multilithed on paper approximately 8 by 10½ inches in size. It includes more detailed data than has been incorporated in this annual report. Copies may be obtained on request from the Forest Service, Washington, D. C.



REPORT OF THE CHIEF
OF THE FOREST SERVICE

1940



U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

UNITED STATES
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Report of the Chief of the Forest Service

1940

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., August 31, 1940.

HON. HENRY A. WALLACE,
Secretary of Agriculture.

DEAR MR. SECRETARY:

As a result of what is happening in Europe and the Far East this Nation now realizes the need for forces strong enough to repel armed invasion.

America's first line of defense is her manpower. Much of our immediate strength also lies in land and water and the resources that spring each year from the union of these two. But much of our potential strength lies in the fact that we can, if we will, manage such living resources so that they will contribute continuously and uninterruptedly to all that we in America hold dear.

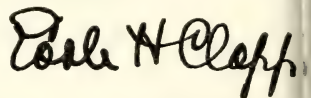
This is significant. One-third of our land is forest land. Wood still fulfills more wartime requirements than most people realize. Timber is one of the world's most universally used raw materials. Forests can be grown with less cultural effort than most other land crops; they have a greater capacity to accumulate stores of such widely used basic raw materials as cellulose; the time of harvesting timber is very flexible. And through labor, agriculture, industry and commerce, forests contribute to Nation-wide social and economic security.

Yet the United States is not handling its forest resource in a manner to insure continuous uninterrupted production, even of certain material needed for national defense. We are still turning timber into cash destructively. We have already created local shortages of certain kinds and sizes. Even our growing stock of good quality timber is being reduced.

In short, although forests are making large immediate contributions to military defense of democracy in the New World and although they can be made a backlog for social and economic security over the long pull, the United States is not yet making adequate provision for defense of her forests.

I am emphasizing these conditions in this annual report because, although solution of our forest problem is essential to adequate national preparedness the forest sector of our agricultural program has failed to keep up with other sectors of it and also because, in the face of ruthless and widespread military conflict and economic competition, it is the nation or group of nations most adequately supplied with natural resources—and with the determination and ability to make the most effective use of them—that has the best chance to survive and prosper.

Sincerely,



Acting Chief.

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CONSTRUCTING tanks and warships and airplanes and manning them with well-trained forces is a necessary and a challenging job. Preventing waste of the Nation's renewable natural resources, building them up, keeping them continuously productive, and using them efficiently, is less spectacular. Yet it is also essential to preparedness. For scarcity of natural resources and their control by the few may pave the way through widespread human misery to despotism and dictatorship; while an abundance of natural resources, accessible to people generally, makes for democracy and freedom.

World-wide studies of forests and other natural resources, of populations in relation to them, and of conditions behind war fronts in Europe and the Far East, point to the need to use our natural resources wisely and well, and to replenish them, if we are to be truly prepared; in other words, we want to be strong enough to repel armed invasion and, over the long pull, enjoy the fruits of peace.

Forests and National Defense

DESPITE steel tanks, duralumin war planes, all-metal battleships and submarines, and the whole gamut of gigantic mechanized struggle on land and sea and in air and stratosphere, wood fulfills many wartime requirements.

Armed forces obviously need wood for such things as pontoon bridges and railroad ties, gunstocks, ships and docks, barracks and munitions, crates, mess halls, hospitals, and post exchanges.

In the World War our allies wanted woodsmen. We sent pioneer forestry regiments, and they operated American and other sawmills in France. A single French army corps is said to have used as many as 30,000 trees daily. England sacrificed timber in her game reserves, and shade trees on her home estates. The United States Army, though in the war for only a short period, required the equivalent of 6 billion feet of lumber.

In more recent years, forests have played a big part as cover for offensive works and military operations. Approximately 20 percent of wood wool has been required in all German uniforms. Wood is about one-half cellulose, and nitrocellulose is a main constituent of modern high explosives. Wood charcoal is used in gas masks. Glycerol, obtainable from wood, is a source of nitroglycerin. The latter, mixed with sawdust, becomes dynamite.

Rosin and turpentine are forest products. The former fills spaces between shrapnel. Turpentine is used in flame throwers. Sawdust, transformed into wood plastics, may come out as instrument panels, switchboards, dial knobs, and many other articles needed

by fighting forces. Not much is yet known about lignin, which is another constituent of wood, but it has already proved its potentialities in warfare. Wood and plywood are largely used, today, in the construction of our training planes. A certain airplane factory in Germany is said to be turning out three wooden fighter airplanes of compressed, laminated, resin-glued wood a day. The United States has already demonstrated methods that give promise of producing upwards of 20 all-wood fuselages and wings per day in plants believed comparable in size to the German one.

This listing, fragmentary though it is, indicates the role forest can and must play in defense against armed aggression.

Forest-land resources also help contribute to national defense on social and economic fronts. Forests help protect the soil. Timber is one of the world's most valuable and most universally used raw materials. It can be grown with less cultural effort than almost any other land crop. No other living product of the land can approach its flexibility as to time of harvesting, or its capacity to accumulate stores of such widely used basic raw material as cellulose. Forest-land forage produces meat, wool, and leather. Forested slopes yield water that makes cultivated crops possible on millions of fertile acres and provides power to run thousands of essential industries. They also make possible forest recreation—the opportunity to rest and relax.

Forests and People

FOREST conservation through wise use is essential for human existence and security. On this continent forests sheltered, fed, and clothed the American Indian. Trees helped make log cabins and cradles, towns, telephone lines, and transcontinental railroads. Each of us still uses wood in many forms every day. Damage to forests, and through them to land and water, threatens human life and the general welfare. In these and certain other respects forests are public necessities.

Forests contribute to the well-being of people. Abused, however, they often create unemployment, low incomes and loss of mass purchasing power, instability and insecurity for labor and industry, and critically distressed rural regions.

The northern Lake States afford an outstanding example of the effects of destructive forest exploitation. Nearly four-fifths is forest land. But only one-tenth of this bears saw timber; more than two-fifths bears inferior stands or is denuded of forest growth. In 1890 the region supplied 37 percent of the national lumber cut.

Now it supplies 4 percent. Probably more than one-fourth of the $\frac{1}{2}$ million population has been on relief—a much higher proportion than in adjacent territory. Incomes are less; taxes are higher. Many counties are on the verge of insolvency. The region is a burden to State and Federal governments.

Washington and Oregon are known as the Nation's wood basket. Yet they already include localities where destructive liquidation is rapidly running its course. The Grays Harbor district was built up almost entirely by forest industries. In 1929 it is said to have contained 34 sawmills and 37 other wood-using plants; in 1939, with old-growth Douglas fir virtually exhausted, it had only 10 sawmills and 21 other wood-working plants and its forest industry pay rolls were only 25 percent of what they had been in 1929.

Testimony presented to the Joint Congressional Committee on Forestry indicates that in 4 Northwestern States 76 ghost towns already have resulted from disorderly forest liquidation and that in another 77 communities the decline of population has kept pace with the closing of mills due to dwindling timber supplies. This is serious because the economic structure of these 4 States is keyed to forest industries that support about 60 percent of the industrial pay roll.

Contrast conditions described in the Lake States with those on an area of four hundred and fifty-odd thousand acres in a certain Southern State. On this area there are 1,300 scattered farm families dependent in part—and a town of 3,000 people wholly dependent—on a forest economy.

At one time the sawmill in this town was cutting timber faster than it was growing. This threatened to stop labor pay rolls that during 35 years had exceeded 27 million dollars, and tax revenues that, helping to support schools and build and repair streets, exceeded 2.8 million dollars. But instead of continuing to exploit the forests, the cut of the sawmill was reduced and a pulp mill and certain other facilities, using largely forest materials formerly going to waste, were installed. This kept up the labor pay roll and the tax payments.

This is not typical of most towns that depend on forest industries. For this town is now on a permanent basis. It, and 1,300 scattered farm families, should be able to depend for all time on production geared to the capacity of the land to grow usable forests. It illustrates potentialities adequately managed forests have for providing employment, raising standards of living, increasing mass purchasing power, and making relief unnecessary.

Forests are public necessities, but great tracts of unproductive forest land are often public liabilities. They generally require State

and Federal contributions that impose burdens on other regions within which land is productive. Many States offer many examples. The following is an instance from Minnesota.

State school aid in 1932 was \$1,300,000 more in 22 northern counties in which largely unproductive cut-over land predominated than in 20 southern counties where the population was almost as great but where the land was used largely to produce cultivated crops. In the same year, within 20 counties where relatively unproductive cut-over land predominated, the State's road and bridge fund exceeded county contributions by 464 percent; but in 20 agricultural counties the State's road and bridge fund exceeded county contributions by only about 40 percent.

No nation can afford heavy public burdens imposed by huge tracts of unproductive forest land. Yet although restocking is fair to satisfy on 71 million acres of commercial forest land, the United States has 77 million acres that are cut over and now practically unproductive. It also has 112 million acres of second-growth saw timber forests characterized by enormous areas of less valuable species and by low-quality stands of more valuable species, 101 million acres that now grow cordwood, much of which is worthwhile but is not saw timber, and, on 101 million more acres that still bear old-growth saw timber, an enormous aggregate volume of less valuable as well as of more valuable species.

But it is not only through timber that forests have to do with the ill-being and the well-being of people.

On denuded mountain slopes every hard rain is potentially destructive. But on that part of about 465 million acres of noncommercial and commercial forest land that has not been denuded by axe and fire and overgrazing, trees and other vegetative cover help conserve and regulate water so it can be used for irrigation, for power, and for domestic purposes. They help to keep downstream flood crests lower and lessen damage to fertile farms and industrial cities. Tree shelterbelts help make Prairie Plains States better places in which to live. Forest-land forage produces meat, wool, and leather, indispensable in war and in peace. And from forest lands come, besides naval stores, maple sugar, tannins, dyes, and other minor forest products that bring returns of close to 100 millions dollars each to rural and urban families often in desperate need for additional cash incomes.

Toward Preparedness

THERE is urgent need for Nation-wide preparedness on social and economic fronts, and with respect to our natural resources as well as on the armed front.

The national forests (p. 21) illustrate, in part, progress toward preparedness with respect to our forest resource. So do the following.

Blitzkrieging forest fires.—The Forest Service drops men and equipment by parachutes to forest fires in mountainous country in western national forests.

Planes first release small 'chutes to determine drift. Trained men follow, using 'chutes which permit a certain amount of steering, and descend about 12 feet a second. Ankle braces and broad leather girdles have so far prevented leg, back, or abdominal injuries. A coil of light rope facilitates descent from tall trees, if and as necessary. Tools, first-aid kits, and emergency rations are attached to separate burlap chutes, but the parachutists carry lightweight radios with which they quickly get in contact with planes and headquarters. Gear, radios, and other special equipment and training methods developed by the Forest Service are being studied by and have been made available to the Army Air Corps.

The Civilian Conservation Corps.—The total number of C. C. C. camps for the whole country remained at 1,500 last year. Of those supervised by the Forest Service, the average number was 322 on national forests, 176 on State forests, and 101 on privately owned forest land. Accomplishments by enrollees in these camps, and in comparable camps that have preceded them during the last 7 years, form an impressive record toward preparedness in the field of forest conservation for human welfare. This record includes, by way of example:

More than 4,500,000 man-days of fighting forest fires; 3,600 camp and picnic grounds developed—on State, county, and community forests and on national forests—so that more people who need rest, relaxation, and inexpensive outdoor recreation may get it more easily; and nearly 1,500,000,000 trees planted so that denuded or fire-scarred forest lands may become productive again.

Progress in systematic training is also progress toward national preparedness. During the last 7 years more than 2 million C. C. C. youths have been trained in camps supervised by the Forest Service in such engineer-troop wartime jobs as truck driving, tractor operation, motor mechanics, operation of road-building machinery, and in heavy construction, building construction, surveying, and elementary engineering.

Much of the credit is due to camp superintendents and foremen for training, for the continued decline in fatal and lost-time accident-frequency rates, and for the character and volume of conservation work done by the C. C. C. But credit is also due to the late Robert Fechner. For as its first Director he organized the Corps and—until his

untimely death on December 31, 1939—guided it in the way it is going.

Timber salvage in New England.—Working through the North eastern Timber Salvage Administration, a part of the New England Forest Emergency Project, and assisted by town committees, State officials, and other Federal Agencies, the Forest Service up to June 30, 1940, had accepted delivery of and paid for 660,385,000 feet board measure of logs, and 59,400 cords of pulpwood salvaged through some 13,500 purchase agreements most of which covered timber on farm woodlands ravaged by the hurricane of September 1938. Payments for forest products, now being offered for sale in such ways and at such times as not to disrupt local markets, totaled \$8,087,300 to June 30, 1940.

Salvage and emergency fire-prevention operations in New England have now passed their peak, and personnel of the New England Forest Emergency Project, many of whom were drafted from other regions of the Forest Service, is being reduced as rapidly as conditions warrant.

Cooperative forest fire protection.—On State and privately owned land, cooperative fire protection was extended last year to almost 279,000,000 acres in 41 States and Hawaii. The protected area burned over was 3,266,090 acres. Damage was estimated at \$7,909,300. Reported expenditures, not including a truly enormous volume of essential work done by the C. C. C., totaled \$9,174,554. Of this \$2,045,243 was private expenditure. But there are still more than 149,000,000 acres of private and State-owned land that need but do not get organized fire protection.

Most man-caused fires are started from carelessness by the public. But fires started by logging and other operations conducted by private owners and operators caused 58 percent of the fire damage within State and private protection units in Oregon, and 31 percent in Washington, from 1929 to 1938, inclusive. Private owners and operators, as well as the public, obviously have a long way to go before preparedness in fire prevention and fire suppression on State and privately owned forest land is adequate.

Farm-forest cooperatives.—These organizations, some of which not only sell forest products but also manage woodlands and manufacture output from them, are increasing in number, though most of them still have financial and other problems that must be solved.

Among the cooperatives that the Forest Service, State foresters, extension foresters, and other public agencies have helped start or establish during the year are: The Worcester County, Md., project; the Clearfield County, Pa., sustained-yield unit; the Carroll County, N. H., Woodland Owners Association; the Essex County, N. Y., Forestry Association; the Forest Products Division of the Clarke County,

Miss., cooperative. With the Otsego Forest Products Cooperative Association of Cooperstown, N. Y., the Preston, W. Va., Forest Products Association, the Tioga County, N. Y., Woodland Owners Cooperative Association, and the Forest Products Association, Inc., of Coos County, N. H., and Essex County, Vt., these cooperatives have more than 3,500 actual and prospective members who own or control approximately 350,000 farm-forest acres.

Planting, farm-forest extension, forest farming.—In acreage, forests rank first among crops on American farms. In value of annual yield, they rank tenth among farm crops. In terms of labor, it has been estimated that cultural and harvesting operations on farm woodlands require only about 1 or 2 days per acre per year, but that properly managed farm forests keep on adding to values at from 2 to 5 percent.

Forestry on the farm helps build a stronger and healthier American agriculture, which is essential both to external and internal defense.

During the 12 months ending December 31, 1939, 64,212,600 trees were produced and distributed to farmers at not more than cost in 41 States and 2 Territories. This was a cooperative undertaking by the Forest Service, the Extension Service, and State forest and conservation departments. In addition, nearly 39,000,000 trees and shrubs were planted by the Prairie States Forestry Project during the year ended June 30, 1940. Operated by the Forest Service on emergency funds, this project has now planted more than 14,140 miles of shelterbelts of which 13,680 miles, or 96.8 percent, are being maintained by the farmers. These shelterbelts will help protect soil and cultivated crops on 22,130 farms in what is popularly known as America's bread basket. Farmers have made the land available. Through contributions of material and labor, farmers also bear at least one-half the cost of establishing these shelterbelts.

With funds made available by the Clarke-McNary and Norris-Doxey Acts, knowledge with respect to protection, management, marketing, and other forest problems, and how to solve them, was furnished, primarily through the Extension Service, to farmers last year by 62 specialists in 41 States and 2 Territories. Advice and assistance were given to 136,200 farmers who made forest-improvement thinnings, 41,400 who made selective cuttings, 338,100 who cooperated in fire protection, and 19,000 who asked for help in marketing their forest products. More than 15,400 demonstrations were held during the year, more than 320,000 4-H Club projects were completed, and forest-farming projects, for which the Forest Service has primary responsibility, were approved in Alabama, Florida, Georgia, New Hampshire, New York, and Texas. This was in addition to work done by the Soil Conservation Service.

The naval stores conservation program.—Authorized by the Soil Conservation and Domestic Allotment Act and supervised by the Forest Service, this program materially affects some 75 million acres within the Southern Pine Belt. It has encouraged better timber-management practices there and through the development of central stilling has helped make it possible for more small outfits to operate their own timber.

Northern Pacific land-grant suit.—The suit of the Northern Pacific Railway Company involves determination of damages claimed by the company to have been sustained through statutory revocation of its right to select lands within its indemnity limits in national forests in Montana, Idaho, Wyoming, and Washington. Decision of the Federal Court for the Eastern District of Washington, appealed to the Supreme Court of the United States, was argued before the spring term of that Court. On June 3, 1940, the suit was set for reargument on October 14, 1940.

Interdepartmental Committee.—The Interdepartmental Committee considered a number of proposals involving transfer of jurisdiction of certain lands between the Departments of Agriculture and Interior, and various other interdepartmental matters. Many were disposed of satisfactorily. In other instances arrangements were made for joint field studies.

Joint Congressional Committee on Forestry.—On March 14, 1938, the President called Congress' attention to the Nation's forest problem. Congress later authorized a Joint Committee on Forestry and directed it to investigate the forest situation and submit a report that is due not later than April 1, 1941.

The Committee has held public hearings in most major forest regions and in Washington, D. C. Among the many people heard have been representatives of the general public, of forest and allied industries, of industrial and farm owners of forest lands, of water-conservation districts, and of community, county, State, and Federal Governments.

Early in 1940, at Washington, D. C., the Forest Service presented background material to the Committee and recommended an over-all action program. Material and program, presented orally, are included in part 8 of the hearings, printed for the Committee's use.

The basic purpose of this program is to create and maintain a Nation-wide economy that, through productive use of forest land, will help guard our freedom and democracy against armed aggression and economic invasion by helping solve such pressing problems as rural poverty and unemployment and creating added security and stability for families, communities, industry, and labor.

Industrial ownership and management.—Representatives of the Forest Service have cooperated in all major forest regions with many

industrial owners of forest land in efforts to secure such better woods practices as may lead to sustained-yield forest management. The Forest Industries Conference, in an advisory capacity, has studied and reported on such problems as the effect of the war on exports, imports, and use of lumber, paper, pulp, airplane spruce, and Douglas-fir peeler logs and on reciprocal trade agreements as they bear on commerce in forest products.

Land planning.—Through interbureau committee assignments the Forest Service is helping develop such departmental land planning policies as those designed to improve conditions of land tenure, integrate forestry and farm programs, improve range management, and develop a rural works program. Interbureau committees, on which the Forest Service is represented, are working on such problems as those relating to rural housing; rural electrification; soil conservation districts; and the agricultural planning program now organized in 47 States, 1,200 counties, and 6,800 local communities. The Forest Service is also represented on State land-use planning committees and has provided technical guidance and advice to hundreds of county and community planning committees.

Research.—Research to find facts and devise new and better ways of doing things is the advance guard of preparedness.

Despite the fact that Forest Products Laboratory was greatly expanded during the last World War and operated on a 24-hour basis then, most of the work it did was not spectacular. Yet much of this research was, and is, essential to national defense. The following are examples:

The indications are that plywood impregnated with resin-forming materials, developed to withstand drastic weathering conditions, is suitable for production of airplanes. "Compregnated wood," with exceptional mechanical properties that apparently adapt it to exacting uses in aircraft, was obtained by compressing laminations first thoroughly impregnated with a resin-forming solution. Wood was found to contain 50 to 52 percent of alpha cellulose with a viscosity comparable to the best cotton, as contrasted to 38 percent obtained by former methods, thus widening the source of high-grade cellulose.

The development of principles of structural timber grading that promote efficiency and economy in low-cost housing contributes to public welfare. This is also true of the development of minimum standards for common lumber grades for sheathing, roofing, and sub-floors worked out for the Federal Housing Authority; of moisture barriers to overcome excessive condensation in walls and roofs of dwellings and barns in severe cold weather; and of insulation of plywood walls and partitions to meet exacting underwriters' standards for fire resistance.

A possible new field of wood conversion was indicated when southern swamp and blackjack oak, chemically impregnated before drying, were found to be thermoplastic, capable of being compressed to high density, and amenable to bending, molding, and lamination. Earlier development of a low-cost plastic from wood waste has now been improved by reducing the time required in the molding cycle.

Research in forest management, concerned with making the most of our forest resource as it now is and with rebuilding and improving it, helps to rehabilitate stranded and economically insecure populations, adds to the stability and security of families, communities, and regions dependent on the forest resource, and strengthens the powers of the Nation to resist economic and armed invasion.

On a pilot-plant scale, methods and plans of growing, harvesting, and utilizing forests are tested under field conditions on such experimental forests as those at Olustee, Fla., Crossett, Ark., Blacks Mountain, Calif., Fort Valley, Ariz., and Upper Peninsula, Mich. When extensive improvement of forest stands was first undertaken by the C. C. C. it was found that the manpower to thin, prune, and weed exceeded the knowledge needed to do the job most effectively. With new research and with surveys of results recently completed in several forest regions, there is available a much stronger technical basis for this work, and every dollar now spent buys more and more worth-while results.

In forest mensuration, distinct progress has been made in developing improved forest-inventory techniques that also give better results at less cost. An improved method of predicting growth in cut-over stands, based on a statistical integration of factors affecting growth, gives unusually precise results. Determinations of rates of growth in cut and uncut forest stands have also been made for several important forest types.

Progress in forest research has helped reduce the cost of establishing new live trees on the ground. As a result of better practices, average plantation survival in the Lake States has been increased recently from 50 to 75 percent. Research in naval stores production has been largely instrumental in reducing production costs from about \$60 to \$53 per gum unit. Breeding to produce trees of faster growth, better form and quality, and of greater resistance to insects and disease is being carried on, and a recent study has indicated possibilities for increasing sugar yield from sap of sugar maple trees through the selection and propagation of high-yielding strains.

Carefully controlled tests of rate of spread of miniature forest fires in a wind tunnel in California, combined with a thorough and fundamental mathematical analysis of fuel and weather variables affecting the rate of spread of forest fires, are now laying a sounder technical

basis for classifying forest fuel hazards and estimating probable rates of spread. Information on speed and strength of attack necessary to control small fires has been obtained from detailed observations of 40 test fires burning under natural field conditions in the northern Rocky Mountains.

Research in forest economics has already helped determine costs of and returns from various degrees of selective cutting in the Pacific Northwest and southern pine regions and in ponderosa pine. It has indicated ways to increase contributions farm woodlands make to farm incomes and has made stumpage and log prices available currently to numerous Federal, State, and private agencies and to individuals.

Research in forest economics enabled the Forest Service to help prepare a report bearing on the probable effect of log exports on labor and domestic industries and on the adequacy of our own supply of high-grade timber, particularly Douglas fir, for use in connection with legislation pending in Congress to restrict the export of high-quality logs. Investigation of the wages-and-hours situation in the southern pine small-sawmill industry, referred to in last year's report, indicates that the margin between operating cost and selling price of rough lumber might be increased as much as \$2 to \$5 per 1,000 board feet, depending on type of operation, if operators can get up-to-date equipment and will adopt conservative selective-cutting practices.

The forest survey (p. 27) continues to furnish information basic to an understanding of the forest situation. It is building up an inventory and ledger account of our forest resource by broad ownership classes. From it come figures needed for preparedness plans on the volume of Sitka spruce, for example, and facts and figures essential to sound private and public policies and programs of land use and industrial development.

Range research furnishes basic facts for the intelligent handling of the western range, from which comes 75 percent of the Nation's output of wool and mohair, and, in pounds, about 55 percent of the sheep and lambs and nearly one-third of the cattle and calves. It also emphasizes the importance of such conservative grazing as that which, during the past 23 years at the Jornada experimental range in New Mexico, indicates that the most feasible rate of stocking semi-desert grassland range with cattle is at a point 25 percent below average forage production. This basis of stocking permits sustained use, helps provide forage during severe periodic droughts, and often cuts down the need for making sacrifice sales. Investigations at the United States Range Livestock Experiment Station, in cooperation with the Bureau of Animal Industry and the Montana State Agricultural Experiment Station, show that conservative grazing of range cattle there costs one-third less than overgrazing.

The need to remove poisonous and noxious plants, mentioned on page 28, is illustrated in western Colorado, where it is estimated that wool growers suffer losses amounting to \$150,000 annually because sheep eat orange sneezeweed that has invaded mountain summer ranges. Certain range-management practices will often help reduce sheep losses from sneezeweed and maintain range productivity, but practical methods for eradication are yet to be found.

Studies by the Northern Rocky Mountain Forest and Range Experiment Station have proven that crested wheatgrass can be seeded successfully and economically on abandoned cultivated fields with an ordinary grain drill adapted to the purpose. Crested wheatgrass-seeded range produced steer gains of 30 pounds per acre as against 13 pounds on native range. Following these experiments, about 250,000 acres of range have been reseeded in Montana alone during the last few years.

Public ownership and management.—There are 196 million acres of publicly owned forest land in the United States outside Alaska. With 67 new community forests established last year, community forests—owned by villages, towns, cities, counties—total about 8 million acres. States own approximately 19 million acres of forest land, of which some 11 million acres are designated as State forests or parks. The rest is in Federal ownership.

This includes the national forests (p. 29). They were first reserved from the public domain, which was largely in the West. They have since been expanded by purchases in the Middle West, the Lake States, the East, and the South, and now constitute the largest area of publicly owned forest land under management in the United States.

The national forests contain one-third of all our saw timber. This constitutes a valuable reserve for use when needed and is being built up through protection, planting, timber-stand improvement, and conservative cutting practices. These operations, plus an integrated plan of land and resource management, materially increase watershed services. This is important in the West for irrigation; in the East for navigability of streams; throughout the Nation for industrial and other power, for flood and erosion control, and for domestic water for cities and towns.

Integrated management on the national forests also makes forage available to more than 50,000 farmers, stockmen, and ranchers for grazing domestic animals under permits. It has helped make possible an increase of 180 percent in big-game populations since 1924. It has also made hunting and fishing and camp and picnic and recreation grounds available to constantly increasing public use in most States and Territories.

The Crux of Our Forest Problem

THE national forests are valuable public properties. They bring added stability to thousands of families, hundreds of communities, and many regions. As development and use increase, so will the power of national forests to add more stability, and more assurance. Their timber, for example, now furnishes only some 4 percent of the Nation's total saw-timber cut, but under sustained-yield production the volume of timber cut from the national forests can eventually be increased at least fivefold.

Even so, three-fourths of all our commercial forest land is in private ownership. This is the best and the most accessible three-fourths, and the most productive three-fourths, for it represents eight-tenths or more of the potential timber growing capacity of the entire country and bears three-fifths of all our remaining saw timber. This 341 million acres of privately owned forest land feeds primary and secondary plants that have investments of about 3 billion dollars. Directly and indirectly, privately owned forest land contributes to social structures—including schools, churches, hospitals—of rural and urban communities and regions. About 13 million people are supported by workers employed in forest industries, in selling and transporting forest products, and as wood-working artisans. With the almost 93 million acres of private forest land that is incapable of growing commercial timber crops, much of the 341 million acres is also important for watershed protection.

The crux of the Nation's forest problem lies, therefore, in commercial forest lands in private ownership, and the uncontrolled exploitation of these lands.

Uncontrolled forest exploitation has brought some benefits in the past. It helped clear land for cultivation, for example. On it a huge industry was founded. So were hundreds of communities. But uncontrolled forest exploitation has been characterized by quick profits rather than by stability, by quick liquidation of tangible values and little or no protection of such intangible ones as watershed values, by industries that move on or fold up, by unemployment, by loss of taxable wealth and of local markets for farm produce, by higher taxes on what is left to tax, by lower family incomes and standards of living, and by higher relief loads.

These are some of the ills that, overshadowing earlier benefits, have now caught up with us; ills that, as a Nation, we can no longer afford.

On some farm-owned forest land some progress toward better management has been made. Close to 30 percent of the 139 million acres of commercial forest land owned by $3\frac{1}{2}$ million farmers is under some form of forest management. But farm forests have been mistreated

till most of them now yield only 25 to 30 percent of what they can and should; one-third of them lack organized fire protection; 70 percent of them are under no form of forest management.

This means that the farmer often has to buy construction and maintenance materials which many farm forests should grow. It means that he gets less forest material, and poorer, to sell. This means, in turn, lower prices and less supplemental cash income. In short, although farm forests are a part of American agriculture, they are not contributing as much as they can and should to help solve its problems.

Some progress in better management has also been made on some commercial forest land in industrial and other nonfarm ownership. One example has already been mentioned (p. 3), and there are others. A recent survey indicates that 2 percent of the 202 million acres in industrial and nonfarm ownership is now under intensive sustained-yield management, that 3.7 percent is under extensive sustained-yield management, and that another 8.5 percent is under such tentative management as may perhaps ultimately result in some form of sustained yield.

This is progress. But in all fairness to the owners who have accomplished it—and to the public whose aid has helped and whose billions are invested in river and harbor improvements, in flood and erosion control, and in irrigation and power and reforestation projects, many of which are affected—account must also be taken of the lack of progress that has been made. For although under certain conditions forestry offers a financial outlook that is not unattractive to private capital, lack of progress among industrial and nonfarm owners is on the whole appalling.

To summarize: More than 85 percent of all industrial and other non-farm-owned commercial forest land—173 million acres—still lacks any form of forest management; and although 137 million of these acres are partially productive, the growing stock there should be built up, and the composition and quality of the forest should be improved. Some 61 million acres—30 percent of the 202 million—still lack organized fire protection. Close to 37 million acres—nearly 20 percent of the 202 million—are so poorly stocked that they may fairly be called nonproducing. Although sustained yield is essential to continuity of output of forest industries and to labor and communities dependent on them, only about 215 out of 1 million or more industrial and other nonfarm holdings are now on a sustained-yield basis; they involve less than 11.5 million out of 202 million acres of forest land in these ownerships.

Moreover, the bulk of our wood is consumed as saw timber. From it are obtained lumber, veneer, cross ties, and much of our pulpwood. The volume of our remaining saw timber is 1,764 million board feet. Three-fourths of this is old growth. But because of poor quality,

inferior species, remoteness, etc., probably not over two-thirds of all saw timber is economically available under present market conditions.

In 1936 the total drain through cutting and losses on our combined forest capital of saw-timber and cordwood-size material exceeded growth by 2.2 billion cubic feet. The drain on saw timber alone, estimated at 47.8 billion board feet, exceeded total saw-timber growth by 15.8 billion board feet, or 50 percent. But because of poor quality and poor species and remote location, not all growth really counts. So drain exceeded effective growth by an additional 4.5 billion board feet. The relation between saw-timber drain and growth is still less favorable because drain includes more high-quality material than growth does.

In short, we are still liquidating forests on privately owned land. We are still creating ghost towns and rural slums. And the public still pays in human misery, in destruction of a basic resource, in loss of taxable wealth, in more and more public funds spent for such things as forest restoration, not to mention reclamation and water-power and Nation-wide flood-control and erosion-control projects.

It may be said that industry is responsible for all this because of its abuse of the forest. But in the interests of truth and justice it must be said that the public is also responsible because of its indifference, and that because Federal and State Governments have allowed it to continue, they share in the responsibility.

In all fairness it must also be recognized that industrial, other non-farm, and farm owners of forest land face many disconcerting and difficult problems. Although private ownership of forest land carries with it certain obligations which, in the interests of national defense and the public welfare, private owners must help to meet, public interests inherent in all forest lands also carry with them certain obligations which the public must meet.

In the Public Welfare

FORESTS are unlike aluminum or tin. Given a chance, they reproduce themselves. They grow each year, and they can be grown and reproduced by man. Instead of exploitation that deteriorates and destroys, this means forests can be continuously harvested and used. Instead of abuse that depletes or wrecks, it means use that will create new and permanent wealth if as a Nation we determine that this shall be done.

Over the long as well as the short pull, therefore, forests can help toward greater security in peace and in war, which is in the public welfare.

The sure way to make them help is (1) to stop destructive forest exploitation; (2) to restore idle forest land to productivity and build

up growing stock on other forest land; and (3) to assure, as rapidly as possible, sustained-yield forest management with increased markets and outlets—continuous crops, permanent industries, more jobs and more permanent ones.

This will take determination and concerted action. We are now exercising these qualities with respect to a two-ocean navy. This navy will give us added security. So will more and better managed forests.

But it takes much longer for an oak or a ponderosa pine tree to reach maturity than it does to build a submarine or a 45,000-ton superdreadnaught. And we have not yet started to exercise the concerted action necessary to build, Nation-wide, for more forests or better managed ones.

Although forests are making large contributions to economic and military defense, we are not yet making adequate provision for defense of our forests. This is an obligation private owners must help meet. For they own the best, the most accessible, and the most productive three-fourths of our commercial forest land. But since this land and the services it and its resources perform are in many respects public necessities, the public must also help meet this obligation.

This poses many problems. Among them are the extent and character of public cooperation with private owners; of private cooperation with public agencies; and of public ownership and management of forest land. Solving these will go far toward solving handicaps of forest land in private ownership, which is the crux of a Nation-wide situation that seems comparable to one faced—and neglected—by certain countries that have since become morgues of former prosperity.

PUBLIC COOPERATION

Limited public cooperation has for years been extended by State and Federal Governments to owners of forest land. Its aim has been to help remove or mitigate handicaps that face most of them. Its justification is the common weal.

There are many of these handicaps.

One group is common to 3½ million owners of farm forests, which include 139 million acres of commercial forest land. Another group is common to some 1 million industrial and other nonfarm owners of 202 million acres. A third group is common to all private owners of forest land.

Recent annual reports of the Chief of the Forest Service have discussed many of these handicaps and ways in which many of them may be overcome. There is no need to repeat those discussions here. But there is need to reemphasize:

1. That public cooperation and aid to private owners of forest land should be continued and increased by the States or their political subdivisions, and by the Federal Government directly or through the States.

2. That the base for public cooperation and aid should be widened.

3. That private owners should also be expected to meet their obligations and cooperate by putting reasonable forest practices into effect on their own lands under such public controls as will insure that these practices are followed.

PRIVATE COOPERATION

Many private owners of forest land have been and are cooperating with local, State, and Federal public agencies in forest fire protection. Through attempts at self-regulation, the lumber industry also undertook to cooperate by improving its woods practices under the National Industrial Recovery Act. This Act was later declared unconstitutional, but some measure of self-regulation is still being tried in the woods by some members of the lumber and some other forest industries in certain sections.

Why, then, should private owners be expected to cooperate by accepting regulation by Government over forest practices on their land?

Among major reasons are: (1) To help protect public interests and welfare and investments of public funds in projects like flood and erosion control and irrigation; (2) to justify and help protect additional investments of public funds needed for similar purposes; (3) to justify increased Government aid to private owners; (4) to make sure society will no longer be left holding the sack by private owners who accept Government funds for cooperative fire protection, for example, and then nullify much of that protection by using destructive forest practices.

What has been said in this report about cooperation with public agencies and about self regulation obviously does not apply to private owners who are operating on a sustained-yield basis. But a recent survey indicates that it does apply to most industrial and other non-farm owners of commercial forest land. The more than 85 percent of the 202 million acres they own still lacks forest management of any kind. Some 61 million acres are without organized fire protection. Among approximately 1,000,000 industrial and nonfarm owners, only 215 are operating on a sustained-yield basis, and properties so managed involve less than 11.5 million out of 202 million acres.

Of course public control to assure reasonable forest practices, as conceived by the Forest Service, will not bring the millennium. For it does not require sustained yield, which alone will assure

continuity of output and employment, and stable support for communities and regions dependent on forest resources.

But if as a Nation we had such public regulation it could stop practices that still endanger common interests in every one of our major forest regions except Alaska, where practically all forest land is in public ownership. It could also lay a solid foundation for and encourage sustained yield. And to the forest-land owner who is really trying to meet his obligations it could give a real measure of protection against individuals who otherwise might continue destructive exploitation.

Public regulation.—Efficiently administered public control as advocated by the Forest Service would (1) stop destructive practices on privately owned forest land, (2) stop deterioration on such lands and forests, and (3) keep them reasonably productive.

Many private owners of forest land have objected to governmental regulation, but a change in viewpoint is indicated. For there are now leaders who, to quote from one of them—

have come to the conclusion that we cannot expect the Federal Government to carry on the present cooperative policy * * * unless we are prepared to accept as a counterpart some reasonable form of public control of cutting methods in the interests of forestry.

Most of these leaders—who recognize that cooperation involves giving as well as receiving—frankly say they prefer regulation by the States. The Forest Service has said, with equal frankness, that it believes Federal regulation would be preferable. The Forest Service still holds this belief. But it has recommended to the Joint Congressional Committee on Forestry what it considers a compromise but a workable plan for public regulation of cutting practices on privately owned forest land. Briefly stated, the principles on which that plan is based are:

1. That States shall have the opportunity to administer regulation, with a reasonable but definite period of 5 to 7 years within which to pass State legislation and apply it.

2. That the Federal Government shall contribute on a 50-50 basis to the cost of such State administration.

3. That State legislation and standards of enforcement shall be satisfactory to the Federal Government, with mandatory provision that Federal financial assistance in regulation be withdrawn if enforcement proves unsatisfactory.

4. That if requested by a State to do so, or if after the formative period the State does not undertake it or does not attain satisfactory standards, the Federal Government shall be authorized to administer enforcement within such State or States.

5. That the Federal Government shall have discretionary authority to withhold other forest cooperative funds, in whole or in part, from any State which after the formative period does not satisfactorily administer or cooperate in regulation.

6. That instead of being uniform, necessary silvicultural and other measures shall be:

(A) Adapted to and vary with local situations and conditions on the ground;

(B) As evolutionary in their development as forest landowner opinion, public opinion, and other conditions permit.

7. That full opportunity shall be assured to forest-land owners directly concerned to:

(A) Participate, along with representatives of public, agricultural, labor, and other interested groups, through advisory boards, in formulating specific requirements which shall be subject to approval by designated and responsible governmental agencies.

(B) Appeal, through nongovernmental boards or other channels, for review and reconsideration of such requirements.

8. That authority of and administrative action by the Federal Government shall be exercised by or through the Secretary of Agriculture.

PUBLIC OWNERSHIP AND MANAGEMENT

Reasonable, planned, and coordinated extension of public ownership and management of forest land offers another method of helping solve many difficulties facing private owners; of more adequately protecting the general welfare; of helping defend life and liberty in the United States against the impact of economic and armed aggression.

Even with more Federal-private cooperation (pp. 16 to 18), there is a big acreage of forest land that is submarginal for such profitable permanent private management as will give the protection that is needed to people generally. Public ownership and management should be extended to such lands as the following: Private forest lands that, like those on important watersheds, need to be managed primarily for the common good; key tracts that if under public ownership and management would make it possible to shift from a temporary to a permanent forest economy in localities and regions where families and communities depend for their existence on the forest resource. Communities and States as well as the Federal Government should be represented in such public ownership and management.

Present indications are that, in a planned and orderly way, public ownership and management should probably be extended by between 140 and 150 million acres. It seems evident, however, that just how much additional forest land should come into each of these forms

of public ownership and management should depend partly on how rapidly progress toward conservation management is made on privately owned lands.

Some Problems of Public Ownership

MOST of the best of our commercial forest land is in private ownership. But in the continental United States exclusive of Alaska there are 196 million acres of publicly owned forest land. And there are problems that—in defense of our institutions and our way of life—need solving with respect to most of this land and its resources.

COMMUNITY FORESTS

About 8 million acres of this forest land are owned by villages, towns, cities, townships, and counties; or by community organizations, schools, churches, hospitals, etc. Community forests furnish timber products; convenient facilities for recreation to townspeople; opportunities for nearby and worth-while relief and other employment; protection to the community's water supply.

About 3 million of the 8 million acres are in more than 1,500 properties. With nearly 20,000 counties and communities in the United States, there is obviously an opportunity—and a need—not only for substantial expansion both in number and in area of community forests, but also for more intensive and better development and management of them.

STATE FORESTS

The States own about 19 million acres of forest land. About 11 million acres have been blocked up and designated as State forests or parks and additional areas as game refuges. The remainder are scattered tax-reverted areas and remnants of Federal grants.

Intensity of administration and use of State forests and parks varies greatly. Practically the entire area is protected against fire and trespass. On more than one-half the State forest area there is some form of timber management. About 45,000 acres are being planted each year. Much of the progress has been made possible through the C. C. C., and Federal grants of emergency funds.

Forty-six States own forests or parks, but 90 percent of the total area is in 10 States. In 3 States the land was acquired largely through purchase. In the others it was acquired mainly by Federal grants greatly supplemented, in Michigan, Minnesota, and Wisconsin, by reversion through tax delinquency. The South, with one-third of the

Nation's forest land, has only one-thirtieth of the area in State forests and parks.

Among perplexing questions facing State ownership of forest land are how to provide for more adequate protection against forest insects and diseases and forest fires, and how to provide such additional development and administration as will permit greater use by more people.

More States recognize that their forest systems should be extended and are trying to increase them through direct purchases and by putting State laws and procedures for transferring long-term tax-delinquent forest land to public ownership on a more efficient basis. The Forest Service believes there is need to stimulate still more the use by States of these and other measures, including wider implementation and use of the Fulmer Act.

NATIONAL FORESTS

The national forests are in general timbered, but include an intermixture of grassland and incidental farm land. A substantial acreage of alpine and subalpine country above commercial timber line is found in the West. About 25 percent of the net national-forest area is non-commercial, and about 50 percent is commercial forest land. Timber is sold under competitive bids; most of the area is available to wildlife; in the West more than one-half is grazed under permits by domestic livestock; and recreational use occurs almost everywhere.

Except in flat sections of the South, and in parts of the Lake States, much of the national-forest area has high watershed values. More than 400 cities and communities get domestic water that comes from protected national-forest slopes that also yield water to irrigate hundreds of thousands of fertile western acres. In the East, as well as in the West, this water also furnishes power for many large cities and industries and many small ones.

So, although most of the best of our commercial forest land is in private ownership, the national forests help produce essential services and raw materials. Over the long as well as the short pull they help toward preparedness.

Demands on the national forests and their resources and services have increased greatly during normal times. Present domestic and world-wide conditions will increase and accentuate many of the problems that already face the Forest Service in its job of protecting, developing, and administering these public properties. Among those problems are the following:

Protection against fires, insects, and diseases.—Protection against fire is better on the whole than it is on most privately owned forest land. But to reduce losses still further it is necessary to handle

fires better in more remote localities and get to many other fires more quickly. In part, this will require more roads, bridges, and trails; in part, further development of the use of airplanes and trained parachute jumpers. The regular protection system should be more fully mechanized.

The blister rust menace to western white and sugar pines is still spreading. Unless control can be stepped up to an emergency basis, these valuable pines must inevitably go the way of the eastern chestnut.

Planting.—In 29 years the national-forest area planted, including replantings, has totaled 1,219,220 acres. The annual average is therefore about 42,042 acres. This progress has been made possible largely by the C. C. C., which may not always be available. This accentuates the need to plant more than 3,000,000 national-forest acres rapidly enough so that they can help produce raw materials and services without unnecessary delay.

Management of resources and services.—National-forest personnel has been trying to carry a work load of essential jobs which exceeds its available manpower capacity by from 25 to 100 percent. This means that even before preparedness demands began to show up, the national forests were unable to provide, to the extent to which they can, and should, services and means of support to dependent families and communities.

There is real need for such expansion of personnel, and physical improvements and equipment as will, for example: Afford more employment to farmers and others by developing more small-timber-sale business; permit more effective management of forage on which domestic animals owned by about 50,000 farmers, ranchers, and stockmen depend; insure better watershed control; help meet the demand for recreation by improving the administration of recreational facilities.

Logging.—There are places where, if it were implemented to do so, the Forest Service might conduct logging operations that, without competing with established industrial operations, would make it possible to (1) salvage cull material and improve the forest; (2) provide additional employment for dependent local people; and (3) stimulate local industries. Such activities should be on a self-sustaining basis.

Cooperative sustained-yield units.—There are also many regions where the remaining forest resource is inextricably mixed between public and private ownership and where unity of management would help put existing mills and dependant families and communities on a more permanent basis.

This presents difficulties, for forest resources in public and private ownership within a natural unit cannot be managed uniformly under a long-time plan without mutual concessions.

One way to solve these difficulties might be to authorize the Forest Service, after appraisals have been made and published, to make sales without bids where such action will assure continuity, security, and stability to established and dependent communities within the unit. This concession on behalf of society should, however, be contingent upon definite and enforceable commitments, by private owners, that will insure satisfactory forest management on their private lands.

Conservative forest practices, on their own lands, by national-forest-timber buyers.—It is not now legally possible to make the adoption of conservative forest practices a condition of sale of national-forest timber because, technically, it would set up inequalities between bidders some of whom may, and some of whom may not, own private land. But it seems reasonable to authorize the Forest Service to make such requirements before public timber on national forests is sold to purchasers who control privately owned timber.

Unemployment relief.—The C. C. C. has helped immeasurably to protect and develop national forests, which have also provided unemployment relief through the Work Projects and National Youth Administrations. But on most of the national forests there is still an immense amount of constructive work that should be done, and many local people who are still in need of part-time jobs.

Certain Common Problems

IN the United States the philosophy of cut-out-and-move-on in the forests has always been dominant. This helped speed things up when our Nation was young. We grew quickly, then; expanded westward into new and virgin country yielding riches that also helped support more people and more industries in the South and the East.

But as we grew from a Nation of 3 million people the quick-liquidation philosophy created and aggravated social and economic ills that now, with more than 130 million people, we can no longer afford to ignore.

Instead of security, this philosophy has brought insecurity to people and communities in many regions. Instead of broadening a raw-material base, this philosophy has narrowed it. Instead of building up a reserve, it has steadily and relentlessly depleted a reserve we once had. Liquidation has also impaired and crippled the power of millions of acres of forest land to create new reserves.

As a Nation we are now in transition between the old philosophy and the new, between quick liquidation on privately owned forest land, on the one hand, and use of forest resources on those lands through sustained-yield management, on the other. But although one way to help keep the United States out of the ranks of nations

that have already succumbed to economic or military invasion, or both, is to stop destructive exploitation of our forest resource now and build it up again, the old liquidation philosophy is still in the saddle, country-wide, among those who own most of the best forest land.

Among difficulties that, common to private and public ownership and management of forest land, must be resolved before the shift from quick liquidation on privately owned forest lands can be effective are (1) The lack of appreciation by the public generally of how vital the forests and the services they perform really are to economic and social well-being generally, and (2) the lack of sufficient knowledge, best and most economically developed through research, about growing, managing, harvesting, and marketing forest land crops, for example.

LACK OF APPRECIATION

If we stop to think about it, we know that in many different forms wood serves every one of us every day. If we keep our eyes and our minds open as we travel, or if we read, there is ample evidence that forests help hold the soil on foothills and mountain slopes; that destructive forest exploitation is a forerunner of more frequent floods with higher crests that, with erosion, all too often ruin fine valley farms and fill rivers and reservoirs with silt; and that floods and erosion also jeopardize projects for irrigation, reclamation, city water and power, and flood and erosion control in which millions of dollars of public funds are being invested year after year.

In the East, West, North, and South, hundreds of ghost towns are mute reminders of man's abuse of living forests. People in what were once well-forested areas but are now rural slums—people who, with low incomes and lower standards of living, endure want and suffering year after year—are distressing reminders and, with widespread unemployment and the dole, costly reminders as well.

There is so much evidence, in so many parts of the country, that if we keep our eyes and our ears and our minds open we must know by now how seriously forest abuse and destruction affect human beings and their institutions. But there is an appalling lack of appreciation of what forests mean; of what they may mean; and of how great the potentialities of our forest resource really are to provide employment and higher standards of living, to reduce the dole and increase mass purchasing power, to help prevent widespread damage by floods and erosion, and to bring added security and stability to industry, to agriculture, and to labor.

We must overcome this lack of appreciation, or we, too, may be indicted for failure adequately to prepare for defense of all we hold dear.

LACK OF KNOWLEDGE

Research in medicine, replacing traditional lore of "simples" and "yarbs," made it possible to understand diphtheria and typhoid and to help prevent these and other ills of the flesh.

It was not until after forest research had started to function that we began to understand many of the economic and social ills of destructive exploitation. Not until then were we able to begin replacing rule-of-thumb methods of using our forest resource by methods that help prevent the spread of, and help cure, these ills.

But although progress has been made, the need for facts has outrun the supply. Forest research in the United States is still in its infancy. There is therefore a big gap between what we know and what we need to know about managed use of forest land, its resources, and the many services they perform.

This is a problem that must be faced. And it is one that requires Federal leadership. For although private enterprise, foundations, universities, and States are engaged in some phases of it, Federal forest research is essential (1) as a basis for improving public ownership and management of forests lands, including 176 million acres already in national forests; (2) to meet the needs of some 3½ million owners of 139 million acres of commercially valuable farm forests; and (3) to protect the broad public interests inherent in all 630 million acres of our forest lands, no matter who owns them.

There is already a framework on which to build for such Federal leadership. It includes 13 regional forest-experiment stations and the Forest Products Laboratory. These are part of the Forest Service organization. They are supplemented within the Department of Agriculture by research on forest insects in the Bureau of Entomology and Plant Quarantine and on tree diseases in the Bureau of Plant Industry. Cooperation is also extended by the Fish and Wildlife Service of the Department of the Interior and by the Weather Bureau, now in the Department of Commerce.

Many problems requiring study are involved in our 462 million acres of commercial forest land. It must be remembered that on this land there are some 862 individual tree species at least 180 of which are of present commercial importance, and that these species appear in an almost infinite number of combinations in some 50 commercially important forest types. To complicate the situation still further, these species differ widely in their life histories; in their soil, moisture, climatic, and light requirements; in their susceptibility to fire, insects, and diseases; in their utilization qualities; and in their reactions to different cultural operations.

The preceding paragraph indicates some of the reasons why much knowledge must be supplied by organized forest research. Briefly,

some of the more important gaps between what we know and what we need to know, have to do with the following:

Timber as a crop.—Collection and storage of seed, nursery practices, selection of planting stock, and methods of field planting have been greatly improved. But with some 30 million acres that should be planted soon and another 45 million acres most of which probably must be planted to make it productive again, there is need to devise techniques for reducing current planting costs and getting better results. Moreover, the field of tree breeding to develop better quality, faster growing, and hardier strains has hardly been touched, and there is as yet no national testing laboratory to insure good-quality forest-tree seed.

Broad general requirements for getting natural reproduction of many of the more important species have been determined. Methods of cutting and brush disposal in virgin stands of western ponderosa pine and western white pine are far more successful than earlier procedures. In the South, as elsewhere, rates of growth and yield for ascertaining degree of stocking and computing future cuts have been determined for many species. But in the hardwoods of the East and South and in the Lake States, for example, a tremendous job lies ahead in developing procedures for the forest manager to follow in rehabilitating forest lands left in underproductive conditions by cutting and fire.

Under many conditions, introduction of more roads and of trucks and tractor logging in the Pacific Northwest permits the substitution of partial cutting for the extensive clear-cutting and broadcast-burning practices which in the past have resulted in widespread devastation. But partial cutting has introduced new questions as to just what method of management will bring the highest returns. To put forests on a sustained-yield basis, the operator needs to know more about such things as what kinds of trees to leave for further growth, how to avoid severe losses from insects and wind, how great a rate of growth may be expected, and how to favor Douglas-fir reproduction and discourage the less valuable species.

Protection.—Methods of preventing and controlling forest fires are far better than they were 30 years ago. Research has helped make this possible. But there is real need to reduce losses from forest fires and costs for adequate Nation-wide forest-fire protection. In this the Weather Bureau can help by continuing to improve and extend fire-weather forecasting.

Forest insects and diseases cause losses which in the aggregate exceed those from fire. Methods of control for many of these enemies have been developed, but there is opportunity through the work of the Bureau of Plant Industry and the Bureau of Entomology and Plant Quarantine to improve current methods, to reduce present costs, and

to develop methods of control for tree diseases and species of insects as yet little understood.

Increasing and improving utilization of forest products.—Forests are essential to society whether or not ample markets for forest products are in sight, but it is only through full and continuous utilization that the forest resource can contribute its full share to national welfare. There is need therefore to maintain and increase old uses for wood and to find new uses. And the base of utilization needs to be broadened through scientific and technological developments.

Progress has been made in these directions, much of it by the Forest Products Laboratory. It is helping keep wood in competition with other materials, and has found new uses for forest products. But woods wastes still amount to nearly one-sixth of the Nation's forest drain, for example, and millions of acres are now occupied with forests almost worthless for timber production unless methods of utilizing small, low-grade trees can be worked out and better uses found for less valuable species which grow in combination with more valuable ones.

Better markets are needed, but so is a word of warning. Although it is often claimed that better markets will bring better forest practices, conditions in many States illustrate the fact that this is not necessarily true.

For instance, with markets not so good in Montana and larch and fir and small pine left there, certain cut-over areas looked relatively good to many foresters. Later, when mills found they could make a profit on props and mine timbers, certain of these areas were recut so heavily that it did not appear worth while to retain them in private ownership. Again, under comparable conditions in south Idaho, operators went back and got every tree that would make a railroad tie when tie prices advanced.

Forest survey.—There is urgent need for an appraisal of our forest resources, of the present rates of depletion and regrowth, and of the probable future wood requirements for different parts of the country and for the country as a whole. This is obviously the first step if forest land—which totals one-third of all our land—is to help as it should toward preparedness against the economic struggle with which we are faced. It was authorized in 1928; was expected to be completed in 12 to 15 years. But the original authorization of funds was too low. The inventory is now nearing completion in the Pacific Northwest, the South, and the Lake States, but this leaves over half the forest area of the United States for which insufficient reliable information is available.

Range management and improvement.—Utilization of forage by livestock is an integral part of agriculture in many forested regions. Many essentials of management, already developed for certain range types in the West, are practiced on public and privately owned lands.

But there is need to develop comparable information for many other western ranges, to improve the opportunity for grazing in forest area of the South, and more closely to define the relations of grazing and forestry in a large part of the hardwoods area from the Ozarks eastward.

There is also need to determine what forage plants and practical methods can be used most effectively and economically to reseed depleted ranges and abandoned dry farms, and to devise less expensive methods to remove worthless and poisonous plants which have invaded ranges in many places.

Wildlife and recreation.—The public interest also requires that wildlife and recreational resources of forest lands be used to the fullest extent consistent with timber growing and watershed management. This calls for a foundation of basic information and for skill and correlated land and resource management.

Forests in flood control, stream flow, and erosion.—Floods and silting up of streams and reservoirs are a growing menace. Other damages, enormous in the aggregate, result from losses of fertile topsoil and pollution and irregularity of stream flow for municipal purposes, irrigation, power, and navigation. These all add up to a staggering bill which the public must pay, in part because of lack of knowledge regarding proper land use practices.

The greatest contribution of science to forest watershed management has been to establish the facts that (1) there is a connection between what happens on the land and what follows with respect to run-off and erosion, and (2) that definite steps must be taken to manage the cover properly if we are to control water on the land where it falls, and if flood and erosion control and regulation of stream flow are to be satisfactorily accomplished.

Studies of limited areas have already shown in a qualitative way how, under a few of the conditions of soil, slope, and rainfall, run-off and soil losses will be decreased or increased following restoration or removal of the plant cover. But these relationships have not been determined quantitatively except on small plots and selected small watersheds. More knowledge is also needed about how and to what extent, under given types of watershed protective measures, water flow can be regulated and controlled, silting prevented, and maximum usable water supplies provided for domestic, irrigation, and other purposes. Additional knowledge like this would greatly increase the efficiency of flood-control measures.

Forest economics and social factors.—Private owners of forest land need accurate appraisals of economic factors and obstacles and net returns in terms of revenue and indirect benefits, of specific policies, and of woods and other practices. If they are to fulfill their

responsibilities, community, State, and Federal forestry agencies need such appraisals also.

Economic research has already helped, for example, to measure the influence of continually changing conditions upon such matters as equitable forest credits; forest taxation; cooperative organizations for farm and other small forest owners; the best use of capital in organizing and managing forest enterprises. It has also helped in determining how far private and public forestry should and can go in supplying employment and returns to labor and land owners and in helping support communities and localities.

Forestry must take account of economic criteria. As has been said, the owner, public as well as private, must compare costs with returns. But neither forests nor forestry are ends in themselves. They have neither meaning nor purpose except as they influence human lives. They have no justification unless that influence is beneficial rather than harmful; constructive rather than destructive. Nor unless it is beneficial to people collectively as well as to the individual.

So forestry must also take account of social criteria. Both public welfare and national defense demand and justify that cutting practices on all forest lands, no matter who owns them, be such as will, for example, help protect communities and regions against floods and erosion and help assure a steady flow of electric power to essential industries, provide unfailing supplies of water to cities and irrigated valleys, and, through forest recreation, present wider opportunities to renew and strengthen the physical fiber and spiritual stamina of the American people.

The National Forests

ONE part of the Forest Service job has to do with forest land in private ownership; another is to protect, develop, and administer the national forests. With purchase units, they included 176,567,095 acres owned or in course of acquisition by the Federal Government in 42 States and 2 Territories, as of June 30, 1940.

In the national forests, which belong to the people, all resources and values are produced for human use, each being developed according to its relative importance. Management is under a highly decentralized administrative system, with headquarters in the Department of Agriculture.

LAND ACQUISITION

There was a steady increase in national-forest area by purchases, exchanges, and donations during the year.

Purchases.—The National Forest Reservation Commission approved purchase of 553,077 acres within national forests and purchase

units at a cost of \$2,202,581. Most of this is cut-over land, with advanced reproduction, but tracts containing virgin timber included: (1) 4,797 acres in the Delta Purchase Unit, Miss.; (2) 4,453 in the Northern Redwood Purchase Unit, Calif.; (3) 6,893 in the Cherokee National Forest, Tenn.; and (4) 7,501 acres in the Ottawa National Forest, Mich.

The total net area approved for purchase to June 30, 1940, was 17,793,135 acres, costing \$66,807,105; the part actually vested in Federal ownership was 17,027,545 acres, costing \$63,991,281.

Exchanges.—The 179 exchanges consummated during the year gave national-forest status to 372,856 acres valued at \$2,147,578. In lieu the United States gave 101,763 acres, including 44,614 acres purchased in Michigan State forests solely for exchange purposes, valued at \$260,574, and 577,879,000 feet of stumpage, valued at \$1,419,142. By these exchanges the net gain in national-forest area was 315,707 acres.

In addition 180 other cases—involving 416,593 acres of land offered in exchange for 13,843 acres of national-forest land and 983,093,000 feet of selected national-forest stumpage—were approved by the Secretary of Agriculture and referred to the Secretary of the Interior or the National Forest Reservation Commission.

Authority was given by Congress to acquire by exchange certain private lands outside the Umatilla, Whitman, and Malheur National Forests, Ore., and the San Juan and Rio Grande National Forests, Colo.; also exchanges of Indian-allotted lands for lands of the Chipewewa National Forest were authorized. Congress also authorized appropriations of national-forest receipts for acquiring lands within the Ouachita and Ozark National Forests, Ark., and the Angeles, Cleveland, and Sequoia National Forests, Calif.

Donations.—To help protect and administer the national forests, 32 tracts embracing 993 acres were donated to the United States for administrative sites, and 16 tracts embracing 16,936 acres for timber production and watershed protection.

BOUNDARIES AND STATUS

Changes made in national-forest boundaries and in the ownership of lands within these boundaries by eliminations and additions during the fiscal year were as follows:

Eliminations.—Transfers from national forests to national parks included: 246,798 acres from the Sequoia and 194,445 acres from the Sierra National Forests, Calif., to the Kings Canyon National Park by Congressional action. The President transferred to the Kings Canyon National Park an additional 10,000 acres from the Sequoia Na-

tional Forest and also a gross area of 187,375 acres from the Olympic National Forest to the Olympic National Park. By act of Congress, 382,554 acres of the Choctawhatchee National Forest, Fla., were transferred to the War Department.

Eliminations during the year totaled 1,021,172 acres, gross, of which 950,676 acres were in Federal ownership.

Additions.—Congress enlarged the Kaniksu National Forest by adding to it all but about 36,000 acres of the 347,387 acres of purchased and public lands within the northeastern Washington land-utilization project. Congress also included within the Siuslaw National Forest, Oreg., a certain 68,563 acres, excepting the intermingled revested Oregon and California lands and public domain, and added 4,350 acres of public domain to the Wenatchee National Forest. The President added 43,332 acres to the Cache and 3,506 acres to the Wasatch National Forests in Utah; also 16,780 acres to the Nantahala National Forest, transferred from the Tennessee Valley Authority. By Executive order, 69,000 acres were transferred from the Idaho National Forest to the Salmon National Forest to facilitate administration.

Additions during the year total 431,138 acres gross, of which some 342,036 acres are in Federal ownership.

Purchase units.—Purchase units given formal national-forest status included: The Clark, St. Francois, Wappapello and Fristoe units in southeastern Missouri, 1,971,885 acres, now the Clark National Forest; and also the Gasconade, Gardner, Pond Fork, and Table Rock units in southwestern Missouri, 1,349,628 acres, now the Mark Twain National Forest. The Illini and Shawnee units in southern Illinois, including about 16,000 acres of the Dixon Springs land-utilization project transferred from the Soil Conservation Service, were proclaimed the Shawnee National Forest, with a gross area of 801,944 acres; in Michigan, 215,969 acres contiguous to the Huron National Forest, was added thereto; the Armuchee division, in Georgia, 231,500 acres, was made a part of the Chattahoochee National Forest.

Protection

THE statement was made in last year's report that, by comparison with 1937, weather conditions and the national-forest fire suppression record for 1938 were unfavorable; that "prevention of man-caused fires, and suppression of large ones, lag"; and that "These are now the weakest links in the chain of effective fire control."

Fire-prevention efforts in 1939 included educational campaigns with newspapers, radio systems, motion-picture theaters, and civic and other organizations. Cooperation was also extended by the Advisory Council on Human Relations, organized by the American Society for the

Advancement of Science. A detailed study in the South indicated what appear to be more effective ways of restraining those who habitually set woods fires.

Yet the statements applying in 1938 to prevention of man-caused fires and suppression of large ones, apply with equal force in 1939. For, as compared with that in 1938, in 1939 the number of man-caused fires increased by 717 to a total 8,555; the number of fires that reached or exceeded 300 acres increased by 83 to 160. Including the area burned by 7,269 lightning fires (1,567 more fires than in 1938), the 291,140 acres burned over was greater by close to 116,200 acres; the estimate of tangible damage to national-forest values, \$1,827,300, was greater by \$1,351,000; with appraised value of work done by C. C. C. and Emergency Relief Administration units, fire-fighting expenditures (totaling \$3,582,900) were greater by \$1,181,500.

Among causes that contributed to the 1939 fire record were: (1) the 2,400 lightning fires between August 21 and 31, and (2) the fact that, because it has not yet been possible to provide longer periods of employment, many experienced fire guards and lookouts continue to find work elsewhere and have to be replaced by less experienced men.

Of the four largest national-forest fires during 1939, two were caused by lightning, one by a campfire, and one by children playing with matches. The father of one of the children sighted this fire immediately, but the spread was so rapid that it burned over 17,000 acres.

The chief epidemics of tree-killing bark beetles were in Idaho, Colorado, and Utah. More than 72,000 trees were treated to destroy broods of insects in them. The work was done in close cooperation with the Bureau of Entomology and Plant Quarantine, which furnished valuable technical advice.

Blister rust continued to spread in western white pine stands of northern Idaho, western Montana, and northeastern Washington and in the sugar pine region of California and Oregon. Work done, largely by the C. C. C., to assure future production of these valuable species, involved removal of wild currant or gooseberry bushes—on the leaves of which the disease passes part of its life—on 491,500 acres. There remain in the national forests about 1,600,000 acres of western white or sugar pine lands from which currants and gooseberries must be eradicated if these pines are to continue to be the foundations of many wood-using industries and communities.

Development and Administration

IN developing and administering the national forests, the Forest Service is guided by the principle of correlated multiple use. Through it, experience proves, there may be created the greatest

aggregate long-time public-welfare values and services from forest land and its resources, including water, timber, forage, wildlife, and recreational opportunities.

LAND

In development and administration—and fire protection—it is generally impracticable to draw a sharply defined line between land and those living resources that spring from the union of land and water. But neither national-forest land nor its resources can efficiently be protected, developed, or administered without accurate surveys and maps, or without an adequate transportation system.

Surveys and maps.—Aerial photographs are essential not only in the preparation of maps but for fire control, range surveys, determining the distribution and density of timber, and many purposes. Aerial pictures were made during the year of 30,724 square miles.

To supplement early maps, topographic and planimetric maps were prepared for areas totaling 19,799 square miles. These maps conform to standards of the Federal Board of Surveys and Maps and are published on scales of $\frac{1}{4}$, $\frac{1}{2}$, and 1 inch to the mile.

Highways, roads, trails, landing fields.—Besides emergency landing fields, the planned national-forest transportation system now includes 24,077 miles of forest highways, 118,307 miles of forest development roads, and 157,501 miles of horse and foot trails. Percentages completed to satisfactory standards are 50, 44, and 71, respectively. In inaccessible country there are 79 emergency landing fields ready for use.

Military routes.—In western national forests and on 96 routes classed as military routes there are now 2,900 miles and 470 bridges that will require an estimated expenditure of \$97,223,500 to bring them to standards deemed adequate for the military purposes for which these 96 routes have been classified by the War Plans Division, General Staff, United States Army.

Special uses and claims.—There were 23,555 pay and 19,522 free permits in force, as of June 30, 1940, for such purposes as pastures, railroads, resorts, summer camps, apiaries, airports, roads, and telephone lines. All were so located that use of the land for semipublic and private purposes did not interfere with the management of the national forests for the public benefit. The revenue yielded to the Federal Treasury was \$363,251.72.

Final application for homestead patents totaled 75. The Forest Service made 53 favorable and 10 unfavorable reports; 12 cases were pending. Mineral claim actions involved 146 cases, of which 55 were reported favorably, 36 unfavorably, and 55 were pending at the end of the year.

WATER

The pioneers found Nature employing every trick in her bag to absorb rains and melting snows. Run-off was retarded by virgin forests, shrubs, and grasses. Absorption was increased by a blanket of humus. Areas of low altitude became marshes and swamps. Pockets and depressions in the mountains developed into ponds and lakes that also acted as natural reservoirs. Run-off from rains and melting snows was slowed down in the spring. In summer the normal flow of streams was sustained by seepage from porous soils and shaded springs.

Then man disturbed Nature's balances. After midwest sod was overgrazed or plowed under, winds began to carry earth half across the continent. Of millions of forested and brush-covered acres cleared for cultivation, many millions, denied protection at least part of the time, have now lost much of their fertile topsoil. Even on millions of acres of wild land, forests have been ravaged or impaired.

Forests and other vegetative cover cannot prevent all floods or hold all silt at its sources. But scientific studies show that in the Ohio Valley 1 inch of forest soil absorbs water 50 times as fast as field soil; that in Maine a good pulpwood stand of spruce and fir intercepts 37 percent of the rainfall. The San Dimas Experimental Forest, established in 1931 as a 50-year experiment, already has evidence that burned mountain sides can send down 20 times as much flood water and 1,000 times as much silt and rubble as unburned mountain sides adequately clothed with vegetative cover.

All of this points to the need to preserve the vegetative cover on national forests from fire and misuse. For these forests help hold America's topsoil from washing and blowing away. Water from their slopes is the lifeblood of irrigated agriculture and of towns and cities.

Progress.—A review of the run-off and erosion conditions in national forests has been initiated to establish specific problem areas more clearly, and to determine causes of erosion and suitable remedial action. An appropriation of \$200,000 was obtained for repair of damage caused in certain national forests by floods in California's Sacramento River.

Power permits and easements.—There are 155 active permits and easements, issued originally by the Forest Service, for operation of electric-power and transmission-line projects. At the end of the fiscal year annual rental fees were being charged on 49 power projects and 63 transmission-line projects; no fees were charged on 32 power projects or 11 transmission-line projects.

The Forest Service was supervising the operation of 435 permits and licenses at the end of the year. Of all applications received by the Federal Power Commission from all sources during the year, 91 percent, or a total of 116, involved the use of national-forest land or Forest Service administration. Increase in applications over the previous year was due principally to rural electrification projects.

TIMBER

More national-forest timber was harvested during the 12 months ending June 30, 1940, than in any one previous year.

One reason for this record is the recuperative power—due in large measure to the cumulative effects of fire control—of forest growth on eastern national forests. Another reason is that the relative accessibility of these eastern areas, in relation to road and other transportation systems and to centers of population, has given foresters the opportunity to salvage material and values and improve quality and growth of the forest.

The Southeastern region, with only about 9 million acres of national-forest land, and most of that purchased after it had been cut over while in private ownership, was second only to the Pacific Northwestern region (Oregon and Washington) in the value of timber cut; not far behind California in volume of timber delivered. The Lake States region, where most land in the national forests had also been cut over before it was acquired, more than doubled its cut in comparison with that of the previous year.

With the limited funds available for making and administering sales, it now seems almost impossible adequately to handle foreseeable increases in timber business on the national forests as a whole. This is particularly true if the Forest Service adheres to its policy of giving preference to sales to the "small" man over larger sales so located that little or no local labor is available.

Timber sold and harvested.—Of the sales of timber made during the year, 25,037 were for less than \$500. Of these small sales, 6,967 were at prices equivalent to the cost of handling, under a law authorizing such rates for farmers and settlers who use the material on their own farms or homesteads. In these sales no attempt is made to obtain the value of the timber, as such. Nevertheless, the average return for all timber sold was about \$2 per thousand board feet more than the costs of administration.

In all, 27,512 sales of national-forest timber and timber products were made during the fiscal year. The stumpage involved in them was equivalent to 1,779,209,000 feet b. m. The net volume obligated in exchanges was equivalent to 1,079,637,000 feet b. m.

Timber actually cut under sales and under land exchanges was equivalent to 1,370,996,000 and 369,275,000 feet b. m., respectively. Receipts for sales of timber, forest products, and as settlement for timber trespasses, totaled \$3,943,023. Timber worth \$981,901 was delivered in exchange operations. The equivalent of about 325,600,000 feet of timber, including dead and down trees, was given away.

Planting.—To many people forestry means one thing—planting trees. As a matter of fact tree planting is only one part of forestry. But it is an important part, for on the national forests alone there are more than 3,000,000 acres that should be but are not growing tree crops for timber production, for watershed protection, or for combinations of purposes.

So although there were 920,000 acres of plantations on national forest land as of January 1, 1940, and although with C. C. C. help 131,892 acres of this total were planted in the calendar year 1939, the planting job is still more than three times as large as what has already been done. The area that needs planting increases as additional lands are acquired and incorporated in the national-forest system.

The Forest Service operates 27 tree nurseries. In 1939 they furnished 132,668,000 trees for planting on national forests and 4,214,000 trees for use by other Federal agencies. Some recent experiments with new techniques in planting of tree seeds indicate the possibility that, in some localities, this method of reforesting idle acres may give sufficiently good results so that it can be substituted, at least in part, for the planting of nursery stock.

FORAGE

Grass, weeds, and browse on the national forests help protect watersheds and build soil. Since forage is also needed by wildlife and domestic animals, economic aspects and services of this resource are correlated, through range management, with traditions and social needs of dependent families and communities.

Allotments, permits, stock.—About 50 percent of the Federally owned land in the western national forests, divided into 9,027 allotments, is used by domestic livestock grazed either under paid or free permits.

In 1939, under a regulation that under certain conditions permits free grazing of not more than 10 animals, 27,106 local settlers and owners grazed without charge 82,224 cattle, 47,734 horses, 13,399 sheep, 6,616 goats, and 46,361 swine on the national forests.

Paid permits were issued to 24,295 owners for 1,180,971 cattle, 27,897 horses, 5,125,642 sheep, 5,965 goats, and 220 swine. Close to 57 percent of the cattle and 64 percent of the sheep grazed under paid permits in the national forests of the six western regions were under 10-year-term

permits. The total number of domestic animals grazed under free and paid permits was 6,537,029, plus their natural increase.

Reductions, trespasses, losses, rodent control.—In localities where it was urgently necessary to protect the range, grazing was reduced in 1939 by 10,546 cattle and horses and 70,085 sheep and goats. There were 13,794 cattle and horses, 34,379 sheep and goats, and about 3,500 wild horses in trespass; 15,000 cattle and 160,000 sheep died from poisonous plants or disease or were killed by predatory animals; and in cooperation with the United States Fish and Wildlife Service, rodent-control work was done on 569,350 acres.

Range surveys and local livestock associations.—The Forest Service cooperated with 776 local livestock associations and advisory boards in the management and administration of national-forest range lands. During the 1939 calendar year some 2,795,000 acres were covered by intensive aerial and ground range surveys. Intensive surveys up to the close of the year covered 53,413,000 acres. Extensive surveys covered more than 16,250,000 acres.

WILDLIFE

Big game on the national forests in 1939 was estimated at 1,926,900 deer, elk, antelope, moose, bighorn sheep, mountain goats, and bears; fur-bearers were estimated at 4,344,200 animals of various species. Birds in unestimated numbers also find favorable habitats on the national forests, and fishing waters include upwards of 70,000 miles of streams plus thousands of acres in natural and artificial lakes and ponds.

The wildlife-management policy of the Forest Service is, as far as may be practicable: (1) To provide and maintain suitable year-long environments according to altitudinal limitations and local and regional possibilities; (2) to restore and maintain appropriate indigenous wildlife populations; (3) to give particular consideration to the importance of wildlife resources to local communities; (4) to integrate wildlife uses and management with other forms of land-use management; (5) to cooperate with State, Federal, and other agencies in obtaining utilization on a sustained-yield basis commensurate with local conditions and social and economic needs.

In general, the total big-game population on the national forests has doubled each decade since 1908. Since 1924 the net increase has been 180 percent.

Except on areas set aside as State or Federal refuges or sanctuaries, most national forests are open to hunting and fishing by the public under State laws and regulations, which members of the Forest Service help enforce. During 1939 nearly 4½ million of the visits by people to the national forests were made primarily to hunt and

fish; forest officers planted almost 289 millions of fish in national forest waters; and it is estimated that financial returns to States and local communities from hunting and fishing on national forests may have exceeded \$100,000,000.

RECREATION

Forest Outings.—The book entitled "Forest Outings," tells how people refresh their spirits in the national forests. It also tells how recreation is fitted into the pattern of coordinated use of all national forest resources; ways by which these public properties help prevent floods and soil erosion and conserve and regulate water; and how the national forests help bring stability and security to families, communities, and regions.

Many people, schools, and libraries have asked for Forest Outings. It is, however, so much more comprehensive than most publications issued by the Forest Service that free distribution is limited. But copies may be purchased from the Superintendent of Documents, at Washington, D. C.

Kinds of outings.—Estimates indicate that in 1939 the national forests received 14,332,000 visits from people who stopped to camp, picnic, swim, fish, hunt, hike, or ride during the summer and fall, and to ski, skate, and snow-shoe during the winter, and 20,471,000 visits from sightseers who were interested in scenery and climatic relief.

To help these visitors enjoy themselves, and to add to their safety and convenience, the Forest Service and the C. C. C. have constructed more than 4,600 free public camps, picnic grounds, and winter sports areas. Here relatively simple facilities, appropriate to forest surroundings and environment, have been installed. They include low stoves or grates, tables, good drinking water, and sanitary conveniences at all improved camp and picnic grounds, plus simple shelters, bathhouses, play fields, and nature trails at some of the more popular ones.

Organization camps.—The need for forest outings is as great among people of very modest means as it is among those who can well afford them. To help meet this need the Forest Service has recently constructed 25 camps equipped with bunkhouses, mess halls, recreation halls, and other structures.

Each of these organization camps is designed to accommodate from 48 to 96 persons at a time; each is located in attractive forest surroundings where swimming, hiking, and play fields are available. The cost to users, or to such public-spirited organizations as often make these camps available to low-income groups, including children, averages around 4 to 5 dollars per week per person. This includes food, lodging, and transportation.

Winter sports.—The recent boom in skiing has created new demands that in 1939 resulted in more than 1¼ million visits by winter-sports enthusiasts.

To help meet this demand, parking areas, shelters, and sanitary facilities have been installed on many areas. To help make winter sports less hazardous to people who are not yet hardy experts, carefully planned ski areas have been developed. More experienced people who seek high adventure have ample opportunities for cross-country skiing over endless stretches of virgin snow, but skiers are warned not to travel alone, or beyond their strength and ability.

Fiscal

FOREST Service responsibilities and activities extend beyond national forests, and it expends funds other than those appropriated for the national forests. In the fiscal year 1940 such expenditures included, for example: Cooperation with States and private agencies in fire control, planting, and forestry, \$2,428,551; contributions for fire control, slash disposal, improvement work, etc., \$2,614,987; for hazard reduction and fire control following the hurricane in New England, \$3,659,565; work relief, including C. C. C. expenditures for camps on State and private lands, on national forests, and on lands controlled by certain other Government agencies, \$32,929,351; research, \$2,133,932; other Government agencies, \$958,760; and miscellaneous, \$681,178. Expenditures for protection, management, development, and extension of national forests were \$30,997,910, of which \$7,798,219 were by the Public Roads Administration for forest highways, and \$2,904,195 for acquisition of additional national-forest lands. Expenditures for all purposes by the Forest Service during the fiscal year totaled \$76,404,234.

Forest Service funds for the fiscal year, derived from 45 appropriations, were allotted to units and subunits by appropriation objects and purposes. Accurate accounting of allotments and expenditures insured use of funds for authorized purposes only. Independent audits extended to regional offices, experiment stations, Forest Products Laboratory, Prairie States and New England projects, national-forest offices, ranger districts, State C. C. C. offices, and C. C. C. camps under Forest Service jurisdiction.

Use of expended funds in connection with individual resources is reflected by 40 major expenditure-accounting captions that, with project-cost records, supply data for administration, the Secretary, Bureau of the Budget, Congress, and other agencies.

Net receipts from the national forests during the fiscal year were \$5,859,184, of which \$1,445,973 was, under existing legislation, returned to the States.

New Legislation

ACTS of the second and third sessions of the 76th Congress which affect the work of the Forest Service are as follows:

APPROPRIATION ACTS

Act of June 25, 1940 (Public, No. 658), making appropriations for Department of Agriculture for fiscal year 1941.

Act of April 6, 1940 (Public, No. 447), making deficiency appropriations, includes \$3,550,000 for expenses for fighting and preventing forest fires, fiscal year 1940.

Act of June 26, 1940 (Public, No. 665), making appropriation of \$280,000,000 for the C. C. C.

Act of June 26, 1940 (Public Res. No. 88), making appropriations for work relief and relief for fiscal year 1941.

Act of June 27, 1940 (Public, No. 668), making appropriation of \$200,000 for reconstruction and repair of roads and other improvements within national forests in California.

Act of June 24, 1940 (Public, No. 653), making appropriations for civil functions, War Department, during 1941. \$2,000,000 is available for transfer to the Department of Agriculture for flood control.

OTHER ACTS

Act of January 17, 1940 (Public, No. 402), authorizing addition of lands to the Siuslaw National Forest, Oreg.

Act of March 5, 1940 (Public, No. 427), authorizing appropriations of receipts to acquire lands within the Ozark and Ouachita National Forests, Ark.

Act of March 4, 1940 (Public No. 424), establishing John Muir-Kings Canyon National Park, Calif., and transferring certain national forest lands thereto.

Act of March 15, 1940 (Public, No. 436), restricting mining locations on an area adjacent to the Catalina Highway in the Coronado National Forest, Ariz.

Act of May 28, 1940 (Public, No. 532), authorizing withdrawal from location and entry of certain national-forest lands in watersheds from which municipalities obtain a water supply.

Act of June 8, 1940 (Public, No. 568), extending exchange authority to and authorizing addition of lands adjacent to the Ochoco National Forest, Oreg.

Act of June 11, 1940 (Public, No. 589), authorizing appropriations of receipts to acquire lands within San Diego County portion of the Cleveland National Forest, Calif.

Act of June 11, 1940 (Public, No. 591), authorizing appropriation of receipts for acquiring lands in the Angeles National Forest, Calif.

Act of June 15, 1940 (Public, No. 631), providing for facilitating administration of national forests with respect to reporting to the General Accounting Office on small permits and contracts.

Act of June 17, 1940 (Public, No. 637), authorizing appropriation of receipts for acquiring lands in the Sequoia National Forest, Calif.

Act of June 17, 1940 (Public, No. 638), extending exchange authority to and authorizing addition of lands adjacent to the Whitman, Malheur, and Umatilla National Forests, Oreg.

Act of June 27, 1940 (Public, No. 668), transferring from jurisdiction of the Forest Service, Department of Agriculture, to the War Department, for military purposes, all Government-owned land in the Choctawhatchee National Forest, Fla.

Act of June 29, 1940 (Public, No. 684), extending exchange authority to lands adjoining the San Juan National Forest, Colo.

Act of July 19, 1940 (Public, No. 754), authorizing transfer of lands in the DeSoto National Forest, Miss., to the War Department for use of the military establishment.

The Honor Roll

EXPERIENCE, vigilance, and judgment are prerequisites to leadership in the Forest Service. And training is the keynote of all C. C. C. activities. Yet the 1940 honor roll includes the names of 13 members of the Corps who, in addition to those previously reported, lost their lives as a result of the gruelling and dangerous job of fighting forest fires.

Heroically risking their lives in a vain attempt to save their buddy, George J. Kennedy, who had broken his ankle, Ernest R. Tippin and Walter James, enrollees of Camp F-5, were also burned to death on July 28, 1939, at a fire on the Toiyabe National Forest, Nev., when the wind unexpectedly changed direction and velocity. Frank Barker and Frank J. Vitale also lost their lives on this same fire in trying to escape the speeding flames. And on April 28, 1940, Jay Von Paris, of Camp F-54, was trapped by a fire on the Lincoln National Forest, N. Mex.

Burning snags, toppling without warning, killed Lorenzo Mazarakos of Company 1235, Louis Pargos of Company 229, Donald Guy Beck of Company 530, Anthony J. Kukowsky of Company 202, and D. Bennett of Camp F-164, on the Kaniksu, Nezperce, Kootenai, and Idaho National Forests, in Idaho.

Clarence Schultz, foreman in Camp F-401, was killed by lightning while fighting fire on the Salmon National Forest, Idaho; and lightning also killed Ervin Voegle, an enrollee of Camp F-14, after he had taken refuge from a storm while fighting a fire on the Black Hills, S. Dak., National Forest.

Besides the above, who were members of the C. C. C., the 1940 honor roll includes: Martin Anderson, member of a blister-rust control crew, who was killed by a falling snag on the Kaniksu National Forest, Idaho; John Gulock, fire fighter, who died from a cerebral hemorrhage, probably due to overexertion while fighting fire on the Columbia National Forest, Wash.; Francis J. Roach, who died of heart failure from fighting fire on the Siskiyou National Forest, Oreg.; Raymond Smith, who was killed by a falling rock while fighting fire on the Snoqualmie National Forest, Wash.; and Harry A. Cave, a mechanic in the Forest Service shop at Redding, Calif.,

who was thrown from a horse and dragged to death while riding from camp to repair machinery on the fire line.

In Memoriam

DEATH took heavy toll, in late 1939 and early 1940, of Forest Service personnel. Among them were:

Ferdinand Augustus Silcox, dynamic and beloved Chief of the Forest Service since November 15, 1933.

He came to this position with a long, honorable, and successful record of leadership in the Forest Service and among industrial and labor organizations. He had an outstanding personality; a warm and kindly interest in people and their problems; tremendous capacity for winning enthusiasm and loyalty; determination to face the facts, and fearlessness and ability to state them with such fairness and dignity as to win respect in low places and in high.

Ferdinand Augustus Silcox died at his home in Alexandria, Va., on December 20, last, of coronary thrombosis. He filled the position of Chief of the Forest Service with distinction, with selfless devotion to public welfare, and with the passionate conviction that, to use his own words, "the Nation's forests must be so managed that they may become tools—and better tools—in the service of mankind."

Edward A. Sherman, Assistant Chief, and Advisor to the Chief of the Forest Service.

He entered Government forest work in 1903, in the General Land Office; became a member of the Forest Service in 1905, when it was established in the Department of Agriculture; was for years in charge of various national forests in Montana and California; became district forester at Ogden, Utah; and in 1915 was drafted for duty in the Washington office.

From long personal experience and deep study, Edward A. Sherman, who died on March 28 of this year, had mastered the history of the public domain and was influential in guiding the transition from the old to the new system of managing public resources for public use. A valued counsellor of four Chiefs, he was admired and beloved in and outside the Forest Service for his scholarly attainments, his keen perception, his sound judgment, his generosity, his delightful humor, and his charming companionability.



UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Forests and People

*Report of the Chief of the
Forest Service*

1941



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UNITED STATES DEPARTMENT OF AGRICULTURE,

FOREST SERVICE,

Washington, D. C., September 15, 1941.

Hon. CLAUDE R. WICKARD,

Secretary of Agriculture.

DEAR MR. SECRETARY: Impacts of the depression, and of the demands for forest products to meet defense requirements, have helped to clarify our forest situation. Both emphasize the need to prepare now for a future that includes critical post-war readjustments.

The depletion of our forests is of long standing, but defense needs have greatly accelerated the process on that best three-fourths of all forest land which is privately owned.

An increasing number of farsighted leaders among forest owners are adopting good forest practices, but most private owners still cling to destructive cutting. The most serious result of this, over the years, has been to help create rural problem areas within more than one-quarter of the land area of the United States.

Millions of farm people live in these areas. So do business, professional, and other people in thousands of rural communities. Most of these areas, which once bore fine forests, have been characterized by widespread poverty, impoverished local governments, heavy drains for relief.

National security makes imperative measures that will stop forest destruction, which has been responsible in part for such social and economic conditions within these widespread problem areas.

Continued and enlarged public cooperation and aid to private owners of forest land will help, but two other measures, and apparently only two, afford the positive assurances that are needed to insure that productivity of forest land which must underlie a sound social economy in these regions. One is public ownership and management of much more forest land. The other is nationwide public regulation of forest practices.

The Forest Service strongly advocates all of these measures but puts particular emphasis on increased public ownership, and public regulation. With strong Federal leadership and action, they are essential to success.

The recent depression, greatly increased defense cutting, the post-war situation fraught with danger unless something is done about it, as well as the needs of the long distant future, all make the need for action more urgent than ever before.

Sincerely,

Josh H. Coffey

Acting Chief.

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Social Implications of Forests

TWO THINGS now overshadow all else. One is that we are living in a world aflame. The other is that our future depends not only on the outcome of this titanic struggle but also on how promptly and how well we prepare for the future, including a post-war period that is certain to be critical. For this future, too, will require a productive agriculture, busy factories, a people at work, and plentiful supplies of raw materials.

Forests have always been one of the greatest and most accessible of all our great raw-material assets. All the lumber cut in the past from forests in California, for example, has been valued at the mills at close to 85 percent of the value of all the gold ever mined there. A value of more than 10 times the 7 billions of dollars we originally provided to help democracy abroad has been placed on all the lumber and other primary forest products that have been cut from all the forests in the United States.

Lumber in abundance and an abundance of other forest products are indispensable to national well-being. So are certain services that forests perform. Helping to prevent erosion and floods is one. Among others are: Providing productive employment and wholesome recreation, conserving water and regulating its flow, and helping to maintain the navigability of streams and harbors. In the aggregate, these and other services rival in importance all the lumber and all the other products from all our forest land.

Land policies of the Federal and State Governments were prodigal when the United States was young. Learning through costly experience that soils are not inexhaustible, we have revised many policies and practices. We are now conserving more tilled soil through wiser use and are getting bigger yields from more of it.

We have also learned that forests are not inexhaustible. The Federal Government and most States have adopted constructive forest policies. Many leaders among farm and industrial owners of forest land are no longer content with fire protection on forest land they own. They have increasingly adopted cutting practices that in a number of cases are as effective as the practices required of operators on national forests. But Federal and State policies of forest-land use are still inadequate. Most operators still cling to destructive practices on most privately owned forest land.

These practices are unnecessary because if forests are cropped instead of mined they can renew themselves. They can produce continuous supplies of raw materials for industry. They can be permanent sources for productive employment. And, as some farm and forest-industry leaders have proved, private owners can operate in this way at a profit.

There are many reasons why destructive forest practices are of vital regional and national concern. One is that the best and most accessible three-fourths of all our commercially valuable forest land is in private ownership. A second is that this privately owned land furnishes about 95 percent of all the lumber and other forest products we use for everyday purposes and for the national defense.

Among other reasons are: That serious and widespread depletion and deterioration of the privately owned forest resource—and of its capacity to produce—still continue; that this has been and still is materially responsible for many critical social and economic maladjustments which, through relief and public aid, make heavy drains on county, State, and Federal financial resources. Yet forests, if they are kept continuously productive, can help to heal many of the social and economic maladjustments—including many of our more critical rural slums—that are described elsewhere in this report.

Forest Depletion

If enough care and forethought are brought to bear on the problem, the United States will have sufficient forest land to grow all the timber it needs for domestic use and for national defense, plus a surplus for export. However, enough care and forethought have not been used. Despite the progress made by many leaders on privately owned forests, and by public agencies in administering community, State, and national forests, there is ample evidence that the forest resource is now badly depleted and deteriorated.

In the Northeast.—In the early days the Northeastern States exported planks to the West Indies and pine masts for the battle fleets of western Europe. Its forests have been heavily and indiscriminately cut ever since. In 1938 a terrific hurricane left close to 2.5 billion feet, board measure, of down timber on some 30,000 farm wood lots and on other holdings. This added to the depletion and deterioration of the forest resources.

The Northeast is now shipping in more than 2.5 billion board feet of lumber each year. Its arrival depends on ships and rolling stock that may be needed to transport food and guns and munitions. Industries and people in the Northeast now pay at least as much for freight on lumber from Pacific coast points as the mills there are getting for much of that lumber. Depletion and unnecessary deterioration of most of the remaining privately owned forests in the Northeast by indiscriminate and often premature cutting of potentially high-quality timber for comparatively low-grade purposes, is now accelerated.

This is true in areas where some 60 percent of the chemical wood now cut is cherry, although among hardwoods it is second in value to black walnut. Also where valuable hard maple is used for charcoal and wood chemicals that could be made from less desirable species; where ash, one of the few woods suitable for handle stock, goes into mine props; where white oak that may later be badly needed for shipbuilding is being cut for smelter purposes; where the number of sawmills has increased greatly, and 12-inch and even 10-inch pines—which

would be worth far more if they were left standing a few years longer so they might produce high-grade piling—are cut for saw timber.

In the Appalachians and the Ohio Valley.—The past century of development in one western county in North Carolina is comparable to what has happened in much of the southern Appalachian Mountains and in much of the Ohio Valley hill country.

The first period was characterized by small farms and the presence of extensive stands of virgin timber covering probably more than 95 percent of the total area. The second period saw the railroads, an influx of people who worked in the woods and in newly established large band mills, and destructive forest fires. This period covered only about 35 years, but saw timber become less and less accessible. Big mills, finally forced to quit or move elsewhere, left depleted resources and hundreds of families who were then dependent for a living on lands most of which were poorly suited to cultivation.

The third period was characterized by many small sawmills. Operating precariously, and usually as a side issue to farming or store-keeping, they took out what little real saw timber remained and persistently and consistently cut much of the young timber which could have helped rebuild the forest.

Now, although some sort of forest cover is still found on 83 percent of the land, most forests are so understocked, so deteriorated, and in such poor condition that many decades must elapse before they can again produce worth-while quantities of high-quality forest products. Most of these wrecked lands are unsuitable for any major purpose other than the growing of forests; but neither the present owners, the municipalities, nor the counties are financially able to restore the depleted commercially valuable forest growing stock.

In the Lake States.—There were once vast virgin forests of pine, spruce, and hardwoods in the Lake States. Now most privately owned forests are decimated by ax, saw, and fire.

What remains of the spruce in private ownership is being clear-cut or high-graded. Only about 1.9 million acres of privately owned hemlock and hardwood saw-timber forests remain uncut. With most but not all large mills operating double shift and cutting destructively, this is going rapidly. With slash and debris a serious fire trap and physical obstruction to reproduction, with soil exposed to drying, and with what young growth there is exposed to loss by drought, wind throw, and sunscald, most cut-over land cannot become productive of high-value forest products short of 75 to 100 years.

On 57 million acres, in 86 counties, there is only a little virgin pine. Most of it is in scattered patches. The bulk of the original pine area is now covered with grass, bracken, scrub oak, aspen, and small jack pine.

Since the Lake States and Sweden have about the same forest area, the contrast between unregulated cutting in the former and the regulated forest economy in the latter is significant. In 1890 the Lake States supplied 37 percent of this Nation's lumber cut. In 1920 they produced less than 7 percent. If present cutting processes on private and continue unchecked, these States may soon find it impossible to maintain an average cut of even 1 billion feet, which is approximately 4

percent of our 1939 lumber cut. After a century of logging, Swedish forests are producing about 3 billion feet of lumber each year. Moreover, Sweden's forests employ 400,000 men as against 60,000 in the Lake States; Sweden meets her domestic needs and normally exports about 70 million dollars worth of lumber a year; the Lake States, although they export specialty lumber, bring in huge quantities of lumber and pulpwood each year.

In the South.—One reason why forests in the South are vital to the national welfare is that they occupy approximately 44 percent of all our commercial forest land. Another is that they produce over 57 percent of the current annual growth of all our commercial forests. A third reason is that southern forests are within easy reach of main consuming markets and furnish more than 40 percent of all the lumber we use.

Drains have been so heavy and so long-continued that years ago three-fourths of these forests were second growth. Even before paper was made in such a big way from southern pines and before the impacts of huge defense orders were felt, more than two-thirds of all the merchantable pine was in trees less than 17 inches in diameter. Most forest land was so badly understocked that it was growing only one-third to one-half the crop it could and should grow, while 10 to 15 percent of all the current forest growth was ineffective because it occurred on trees that were unmerchantable.

Fires cause up to perhaps 13 percent of the drain on forests in the South. In 1940, 151,782 fires burned over more than 24 million acres of privately owned forest land and caused damage estimated at more than 30 million dollars.

With 116,490,000 acres in the South still without organized fire protection but needing it, drain from fire may continue. But so may the much heavier preventable drain that still deteriorates a large proportion of southern forests through unwise methods of cutting. For although gratifying progress in better forest management has been made, cutting on privately owned forest land by a big percentage of southern mills still deteriorates second-growth as well as old-growth forests on huge areas and depletes much of the best of the growing stock.

In California.—This State has 13.6 million acres of commercial forest land. In 1939 it furnished lumber and other timber products valued at 87 million dollars. Its forests are the major economic support of 15 counties. They contribute in a big way to the support of 13 additional counties. Wood-working industries furnished 10 to 15 percent of California's industrial pay roll in 1939, and some 400,000 persons were directly and indirectly dependent on forest industries.

There are two major forest regions in California. The coast redwoods is one. The other is the pine region.

Exclusive of some 50,000 acres in State parks, the redwood region includes about 1.4 million acres of commercial forest land. Of this, 850,000 acres contains some 45½ billion feet, board measure, of uncut or virgin timber, while destructive cutting and other practices have covered about 500,000 acres. More than 400,000 of these cut-over acres are poorly stocked with young growth.

Selective logging can be used to remove the financially mature trees without excessive destruction to the immature stand and to provide for natural regeneration under favorable conditions. Present forest practices are in some cases much better than they were, but the only operator who owns enough stumpage for a sustained-yield operation on the basis of existing capacity has left less than 10 percent of the 3,000 acres he has logged in a recent 3-year period in a productive condition.

Approximately one-half of the California pine region is within national forests. These public properties were not set aside until most of the best and most accessible forest land had passed into private ownership. It is not surprising, therefore, that private forest land furnishes 88 percent of the current cut of lumber in the pine region in California and that some 60 percent of the land has already been cut over.

Operators of national-forest timber are now required to leave at least 35 percent of the original pine volume in trees 12 inches or more in diameter. This maintains and builds up the growing stock. A second cut should be possible in about 35 years. Most operators on most privately owned forest land leave more pine than formerly, but they still leave less than 10 percent by volume of the pine trees 12 inches or more in diameter. This depletes the capital stock. It also threatens a hiatus of at least three-quarters of a century before a second cut on lands so operated will be commercially feasible.

The best data now available indicate that, for the pine region in California, annual depletion of saw timber from fire, insects, and cutting is six times the annual saw-timber growth. These data also indicate that present rates of cutting the privately owned timber may mean the abandonment of 50 percent of the existing pine mills in 40 years or less; an annual loss of about 20 million dollars in returns from forest products; lack of employment—unless some other source can be substituted—for workers who now directly support about 100,000 people; and the economic collapse of a dozen or more counties.

In the Pacific Northwest.—There are also two distinct forest regions in the Pacific Northwest. The Douglas-fir region lies west of the Cascade Range; it contains about 26 million acres of forest land and 600 billion board feet of timber. The pine region is east of the Cascade Range; it has about 18 million acres of forest land and approximately 141 billion board feet of timber.

There are 20 national forests in Oregon and Washington, but before they were created private holdings were built up until in recent years 4 companies controlled 2.4 million acres, 30 owners held nearly 1 million acres, and private owners as a whole controlled the best two-thirds of all the accessible timber, including most of the key areas, in the Pacific Northwest. In this and in other ways private owners dominate a situation that, despite real improvement in cutting practices on considerable privately owned forest land, shapes up about as follows:

In the cut-over parts of the pine region in eastern Oregon and eastern Washington almost half a million acres of privately owned

forest land have practically no young growth. On a much larger area the reserve stand is insufficient to permit a worth-while second cut for perhaps a century. The Klamath and Deschutes districts of Oregon are already threatened with social and economic troubles that have so often followed destructive or excessively rapid cutting of the forest resource. Throughout the eastern Oregon and Washington pine region generally the privately owned pine timber that is big enough to operate will probably be exhausted in two decades or less at the present rate of cutting.

In the cut-over part of the Douglas-fir region of western Oregon and Washington there are about 3 million acres in private ownership that are restocking so poorly that they may be classed as idle. A substantial part of a much larger area is understocked with young growth that, purely volunteer, cannot be credited to any human effort; and there is a marked increase in the cutting of young stands that might better be left to grow until they are 100 to 150 years old.

In the Douglas-fir region of western Washington the Grays Harbor and Puget Sound districts are already pinched. In this region as a whole, where before the defense program started there were half a million people who depended on forests, there are now only about a score of private saw-timber holdings with enough big timber to last for more than one decade at current rates of cutting.

Western Oregon has more than 56 percent of all the timber in the Pacific Northwest's Douglas-fir region. About two-fifths of it is unavailable under present conditions. Some counties have already been largely stripped of their timber. The Tillamook fire alone took toll of about 10¼ billion feet in 2 days. Privately owned timber of western Oregon as a whole is now threatened by the migration of forest industries from western Washington and elsewhere.

These conditions are of vital national concern because they affect the greatest and one of the last reserves of virgin timber in the United States—one from which comes each year a full one-third of all the lumber we use. They are also of vital concern to people who live in Oregon and Washington because in these two States there are about 44 million acres of land that, in general, cannot be used economically except for growing commercial forests. Also because forest-industry pay rolls, which constituted 58 percent of all the industrial pay rolls of the two States before the defense boom, cannot continue if current rates and destructive methods of cutting are continued.

In general.—Widespread depletion on privately owned forest land has led to unfavorable relationships between forest drain and forest growth in the United States. Poor cutting and other practices on privately owned forest land have deteriorated much of what remains of the forest resource.

Even in 1936, when economic activity in most forest industries was materially below predepression levels, all forest growth was less than all forest drain. About one-sixth of this total growth was on defective trees, weed trees, and others that were economically unavailable.

Saw-timber stands occupy less than one-half of all our commercial forest land. They require relatively long periods to grow. They fur-

nish most of our wood requirements. But saw-timber growth, even in 1936, was only two-thirds as much as saw-timber drain.

Privately owned forest land furnishes close to 95 percent of all the timber we cut. Recent increased drains are indicated in part by trends in lumber production. In 1936 we cut 24.4 billion board feet; in 1939, 25 billion; in 1940, 27 billion. With perhaps some 3 billion feet more needed for our new Army right here at home, output may reach 32 billion board feet in 1941 and again in 1942.

Increased consumption of paper and the reduction in imports of wood pulp from Europe have also led to heavy forest drains. Paper consumption in 1938 was 13.4 million tons. It is estimated to have increased to 16.5 million tons in 1939 and 18 million tons in 1940. Consumption of pulpwood, which was 9.2 million cords in 1938, increased to 10.8 million cords in 1939 and to about 14 million cords in 1940, and we now have need for larger and larger amounts for normal uses and for defense.

Defense demands must be met, but they have widened the gap between forest drain and effective forest growth. Destructive forest practices of the past have helped increase erosion of land—which is basic to all life. They have helped increase the frequency and the height of destructive floods and the silting of reservoirs and rivers and harbors. All this has brought home, as never before, the need for measures that (1) will stop current destructive forest practices—which are widespread but unnecessary even for defense—and (2) will also give other assurances that are even more important.

Rural Problem Areas

Heedless and needless forest abuse in region after region has contributed to the creation and perpetuation and extension of many critical social and economic maladjustments.

One is idle or largely idle forest land—77 million acres of it—and much larger area that is only partially productive, most of which is capable of producing continuous crops of timber, forage, and other plant cover that would help to alleviate damage from floods and erosion, to furnish continuous employment, and to contribute permanently to the support of families, business enterprises, and communities.

Widespread financial chaos among local governments is another maladjustment. One of the Lake States offers one of many pertinent and very real examples. In 1926 this State's tax commission reported 9,800,000 acres of forest land on its tax rolls. Local units levied about \$5,423,000 of taxes on these lands. In 1939 the commission reported only 9,781,000 acres of forest land, against which only about \$1,590,000 in taxes was levied. One county, typical of many others, had 187,000 acres of land bearing merchantable timber assessed at \$3,610,000 in 1926; in 1939 there remained only 32,000 acres, assessed at \$582,000.

Many other local governments have also been crippled since private initiative wrecked old-growth and second-growth forests. The value of nonmineral rural property in 14 once well-timbered northern Minnesota counties shrank 57 percent in 18 years. Now 5 of these counties

have less than 2 million dollars of valuation; 2 have only one-half million. In attempting to provide even a minimum of essential public services, several counties have had tax rates exceeding 20 percent of their assessed valuations. In some townships and school districts they reached the absurd figure of 110 percent of value.

All this is reflected in wholesale land abandonment and tax delinquency; in a tax burden that now rests on only about one-third of the land and must of necessity be assessed mainly against business establishments and farms and homes; in defaulted bond issues; in high relief loads that must be paid by State and Federal Governments; in a chaotic condition that escapes bankruptcy only because of outside aid.

Destructive forest exploitation is not wholly responsible for the conditions and maladjustments mentioned, but it has induced and contributed to many of them. It has also contributed to unfavorable social and economic conditions in rural problem areas in some 1,250 counties having a large percentage of forest land. Within these counties there lived, in 1929, a large proportion of the more than 1.7 million farm families having a gross yearly income of less than \$600, which means a net yearly income of perhaps \$300 for family use.

One-half of the Nation's farmers live on some 500 million acres in these counties. Men, women, and children in rural slums within these counties must depend in large part on meager crops grown on land much of which always was submarginal for cultivation, and most of which has become less and less productive with years of tilling and erosion. In order to get a little cash, family after family must engage in scavenger operations in forests already crippled by industries most of which have either quit or moved elsewhere.

Birth rates are highest in these problem areas. Families are largest. Diets and clothing are inadequate pretty generally, as are decent shelter and schools and roads and churches and medical care. And the grinding heel of poverty has left young people—who flock to the cities and towns of America—physically and temperamentally ill-equipped to take their rightful places as citizens of this or any other self-respecting democracy.

Rural slums had already begun to show up in the Pacific Northwest before the national defense program got under way, but most of the worst of these sore spots are in cut-over areas east of the Great Plains, where the potentialities of forest land offer an important means for human rehabilitation.

The Cumberland Plateau.—This is part of the Appalachian region referred to on page 3. As the number of families increased after it was first settled, farms were subdivided into smaller and smaller units; cultivation was extended to steep slopes and ridges; they, deprived of vegetative cover, soon lost their thin layers of productive soil. When the lumber industry came and coal deposits were opened up people flocked to sawmills and mining towns. After forests were degraded and crippled, and after men were laid off in the coal mines, many people were forced back onto worn-out mountain farms.

Including the value of produce consumed at home, per capita incomes before the depression averaged \$150 or less yearly in most

counties. During the depression the average annual cash income for full-time farmers was \$114 in one county, and 20 percent of the farm families took in less than \$40 a year.

According to one survey, nearly 80 percent of 1,935 families in another part of the Cumberland Plateau lived either in log cabins or "box" houses with walls commonly covered with newspapers, with windows unscreened, and with roofs that were often leaky. One-third of some 230 farm homes in one county had outside toilets that drained to domestic water supplies. Fifty-three percent of them had no toilet facilities of any kind.

Similar conditions were encountered in hilly sections of other counties. Average farms had only 1.3 acres of level land on which to produce food. The death rate from tuberculosis, pneumonia, typhoid fever, and diarrhea was high. Registered physicians were so far away that, at \$12 per call, they were economically unavailable. Lack of money to buy jars and caps prevented adequate canning of vegetables for winter use. Undernourishment and malnutrition were common, the general level of physical efficiency was low, and old age came prematurely to men and women.

Northern Minnesota.—This area presents an outstanding example of widespread and critical social and economic maladjustments that stem from forest exploitation followed by scattered settlement, submarginal farming on soils that are thin and costly to clear, and overdevelopment of public facilities.

As virgin forests in northern Minnesota were disappearing, agriculture developed gradually. Shortly after 1900, thousands of stranded woods workers and other thousands of hopeful settlers from the Central States were induced to buy cut-over land. Then this land boom collapsed.

Since then some farmers have been able to make a good living where specialized crops could be produced or as recreation and mining developments or a few residual forest industries have provided part-time employment. But after 30 years, 85 percent or more of the cut-over region is still wild land. A survey in 1934 revealed that there were at least 5,000 farmers in need of relocation before they could hope to make a living by cultivating the soil. Other surveys have indicated shockingly subnormal and almost unbelievably difficult and discouraging living and working conditions. For example:

In 1939 there were 75 farmers on cut-over land in one district in one county in northern Minnesota. To get to the nearest all-weather road many of these farmers and their families had to travel for 10 to 15 miles over corduroy roads that, in bad repair, were almost impassable during some seasons. Many homes were makeshift shacks. Average annual cash income per farm was \$319. Only 20 percent of this came from farming. With woods and other outside work near the vanishing point, direct relief and other public-assistance programs were the chief sources of cash incomes for 40 percent of the farmers.

Conditions encountered on these 75 farms are reflected, time and again, in most if not all of those Lake States cut-overs described on page 3.

The South.—There is prosperity in the South, but in parts of it poverty is also prevalent among rural populations. Many factors have contributed to this poverty. They include nonresident ownership of lands, farm tenancy, one-crop agriculture, loss of markets, soil erosion, and the boll weevil. But although marked progress in better forest management has been made recently in parts of the South, so much of its forest resource has been—and still is—subject to destructive exploitation and repeated fires that in altogether too many areas the productivity of forest land has been reduced to a point where it can no longer contribute very much to incomes that are unbelievably low.

County after county in the South affords pertinent and revealing examples. Here is one. It is typical of more than 100 Piedmont counties in several States.

There were once fine forests on more than half of this county, and enough land was cultivated to support 692 families. After the sawmills came there were more than 3,000 families. After the sawmills left 66 percent of the families were farm tenants; all of them were struggling to get by on less than one-half the acreage that had formerly been cultivated. Although nearly 70 percent of all farm holdings were still forest land, the forest resource had been gutted to a point where people could no longer make wages at woods or sawmill work or depend on local markets for cultivated crops.

The Missouri Ozarks.—The Missouri Ozarks include some 35 counties that were originally clothed with a continuous forest of mixed pines and hardwoods. The best valley-bottom lands were settled in the early 1820's. Population increased rapidly. Many steep and less fertile hillsides had to be cleared and farmed, but large-scale lumbering—which started about 1870—provided enough off-farm employment so that relative prosperity reigned for a time.

Lumber production was almost 725 million board feet in 1899. By 1939, with only sporadic operations, it was only about one-tenth of that. Most opportunities for off-farm jobs had vanished. Then more and steeper hillsides were cleared, cultivated, and eroded. Widespread and repeated woods burning was resorted to in an effort to increase range forage for livestock. This deteriorated the forests still more. So did culling operations that, bringing in a little cash to local people, generally removed seed trees and the best of the usable young growth.

Now there are less than 150,000 acres of old growth in the entire region. There are only a few second-growth stands that have trees more than 10 inches in diameter. Relatively few sound trees were left after cutting and many of them are now rotten and defective because of repeated fires. Estimates indicate that at least one-half the topsoil has been lost from steep uplands that have been cultivated. There has been a one-fourth loss of soil from heavily grazed woodlands. Floods have been aggravated. These conditions, induced in large part by heedless exploitation and deterioration, have brought lower incomes—and lower and lower standards of living—to a population that has consistently grown at a rate 50 percent greater than the State-wide average.

In 1929 average gross income of all the approximately 13,000 farm families in the 35 Missouri Ozark counties was less than \$600. Only about half of this was available for family living. Net annual incomes for farm products in one county ranged from \$119 to \$190. From one-third to one-half the entire population of many Ozark communities has been on relief pretty continuously for many years. Relief costs totaled \$11,237,000 for the period 1932 to 1936.

Northern Idaho.—There are 10 counties in what is known as Idaho's Panhandle. They include about 12.5 million acres, of which 82 percent is forest land. Most of it originally supported fine stands of virgin saw timber. Large-scale lumbering started shortly after 1900 and rose to a peak in 1925. Since then some big sawmills have consumed all or most of their white pine and ponderosa pine saw-timber supply; some have quit operating because of financial difficulties; 12 fewer mills with capacities exceeding 10 million board feet yearly are operating now.

What remains of north Idaho's white pine is the backbone of what remains of its lumber industry. But much of the cut-over pineland has been abandoned by its private owners. Only about 10 percent of what remains of the privately owned pineland is being operated with a view to a second cut or for long-time ownership. The average annual output of white pine for the period 1935-38 was 2.5 times what it should be for permanent production. Continuation of this rate of cutting threatens to reduce the 1935-38 average output of pine by four-fifths within 20 years. If protection and management of all forest lands were intensified, the sustainable cut of white pine could be greater than it is but still much less than the present rate of production. As a consequence of overcutting, there will be a substantial reduction in the number of large mills in another two decades unless a sustained market can be developed for secondary species.

Thousands of families came into this country from the drought-stricken Midwest in the 1930's. Many of them bought cut-over forest land. A survey indicated that 44 percent of these tracts in two counties had no cleared land and no improvements. A Herculean task, clearing proceeds at an average rate of only 1.7 acres per year per tract. With at least 60 cleared acres necessary for an adequate farm income, it seems as if most of the 50 percent of these new farms that experts say may perhaps ultimately support families in these two counties may be unable to do so except in generations to come.

In comparison with the Cumberland Plateau, Idaho's Panhandle is a new country with fewer people who live in poverty. But it seems that this new country already has conditions—and forest practices—which helped cause social and economic maladjustments to fester and spread in the Lake States, the South, and elsewhere.

In summary.—Rural slums are not purely local. Those cited are examples of hundreds that occur within some 500 million acres where the forest resource has been crippled but still offers what appears to be a major opportunity for sound social and economic rehabilitation. Rural slums affect the lives and the outlook on life of 8 millions of farm people—and of many thousand others in rural villages—who

have been trying to exist on an average income of not more than \$2 per person per week.

This means poor shelter, poor diet, and poor health. It means inability to do a good day's work if, as, and when it is available; lower incomes and underemployment in cities and factories because so many farmers have so little purchasing power; high relief loads that must be carried by more prosperous farmers and by business and professional people who live in towns and cities; young folk who are physically, temperamentally, and educationally poorly equipped to function as future citizens.

Assurances Are Necessary

WHAT HAS BEEN said about forest depletion, rural problems, areas, and the relationships between them indicates the need for such positive assurances as will (1) stop forest exploitation on privately owned forest land and (2) keep such land at least reasonably productive. The failure to safeguard expenditures of public funds that have been made on privately owned forest land generally, and public investments that—in flood and erosion control and in irrigation and the dredging of navigable rivers and harbors and similar projects—so often depend on the continuity of forest cover on so much of the forest land that is in private ownership, lends emphasis to this need.

Public Cooperation Essential But Assurance Lacking

AS IS INDICATED later in this report (p. 23), State and Federal Governments cooperatively have helped to protect privately owned forests from damage and destruction by fire, insects, and disease. They have also helped to build up existing farm forests, to stimulate private initiative and secure better woods practices on the part of some leaders among large as well as small owners of forest land, and to increase incomes from some privately owned and operated forest land.

The scope, character, and diversity of the problems that affect most private owners of forest land, and the public interest inherent in this land and the services it and its resources perform, warrant public cooperation and aid in establishing cooperatives for small owners. These cooperatives should help the smaller businesses to hold their own in competition with large ones. Long-time public credit for industrial and other owners, including small-owner cooperatives, who agree to follow prescribed forest practices, also seems justifiable and advisable.

There is need, too, for help in setting up cooperative sustained-yield units within which private and public forest-land resources may be pooled under management that will assure more security and stability to established industries and communities. More research and

advice are also needed regarding methods of growing and harvesting and marketing forest crops more profitably, about how to manage forests so as to build up the amount and value of the annual yields from them, and about adapting forest taxation to the nature of forest undertakings and, indirectly, to helping stabilize county and State incomes.

More research and assistance are likewise required to hold existing markets for wood and other forest products and to secure new markets. This is particularly so for tree species and parts of trees now left in the woods. Research is needed also to help more home owners and other users to get more and better services from wood and wood products at more reasonable costs.

In most of these ways there has not been enough public cooperation and aid. Both should be continued and expanded. But while these measures have been in the public interest, the time for temporizing—for depending entirely or even largely on them, on the initiative of private owners, or on chance—has passed. There is need, now, for assurances that will stop private forest-land practices that have depleted and deteriorated a vital and a renewable resource nationally as well as regionally; and that have also helped to create and aggravate most of the worst rural problem areas on more than one-fourth of all land in the continental United States.

For destructive forest practices within this huge area have in too large part been responsible not only for heavy drains on State and county resources but also for widespread human misery and loss of self-respect and of public morale. They have, in short, struck at the foundations of a democracy that must provide opportunities for people to earn decent livelihoods if it is to endure.

Two Measures Do Offer Assurances

USED SO that they supplement and complement each other, two measures—and apparently only two—afford such assurances. One is public ownership and management of more forest land by communities, by States, and by the Federal Government. The other is Nationwide public regulation of cutting and other forest practices on privately owned forest land.

Public regulation is needed to help protect the last and greatest reserve of virgin timber in the Pacific Northwest, most of the best of which is privately owned, from destructive cutting and deterioration; but public ownership and management of more virgin timber—including key tracts—is needed to help protect this reserve from excessively rapid depletion.

Public ownership, with public management like that on national forests (p. 27), offers assurance against destructive cutting and deterioration on land so owned and managed. But this assurance does not apply to land that is or may be in private ownership. To keep such land even reasonably productive continuously, public regulation is needed.

Lack of management on privately owned land that is intermingled with and adjacent to State forests and national forests often vitiates the effects of sound management on these publicly owned properties. This handicap could be overcome by extending public ownership and management to privately owned key tracts—a measure that would assure more effective and more economical protection and administration—and by applying public regulation to the other privately owned land.

Large areas of forest land are submarginal for private ownership. Extension of public ownership and management to this type of land, also, would help solve this problem. But public regulation is needed to help protect private owners who are redeeming their resource and their social obligations from other owners who are not.

Public regulation is needed to help keep private ownership—which is now on trial—in the forest-land picture in a big way. It is needed to protect thrifty second growth in the South, in the Northeast, and elsewhere from destructive cutting and deterioration. It is also needed to assure protection from these practices to virgin redwood in California, and the remnants of old-growth pine and hardwoods in the Lake States. But so is extension of public ownership and management if these and other forests are also to be protected against rapid depletion.

Restoration of wrecked forests like those in the Ozarks (p. 10) and the Cumberland Plateau (p. 8) seems to be the one best and most practicable way to help rehabilitate millions of people who live in rural slums in 1,250 of the three-thousand-odd counties in the United States. Private ownership offers no assurance that this will be done. What is happening in the Lake States proves, however, that extension of public ownership and management—accompanied by public control—does.

Most of the publicly owned land in most of the national forests in the Lake States was bought after the forest had been pretty well wrecked. Purchase programs are still only 35 to 60 percent complete, but young trees have already been planted on more than 591,000 publicly owned acres. On hundreds of thousands of other publicly owned acres controlled cutting of timber has removed low-value trees. This has improved the composition and the growing condition of forests. With other controlled cutting in some of the older stands, it has resulted in the harvesting of more than 116 million board feet of national-forest timber during the fiscal year 1941. Besides bringing in \$315,225 to the Federal Treasury—25 percent of which will be returned to the counties—harvesting and primary manufacture of this timber represented an average of 5 months of work for 4,220 people. More than 3,200 timber sales were made during the 1941 fiscal year. Approximately 3,100 of them were “family size.” These cost a little more to administer than larger sales did, but they made more work available to more local people and helped keep more of them off the relief rolls. So did work in developing recreational facilities, including those needed for winter sports.

There are many illustrations of how public ownership and management of forest and other wild land offers assurances against damage

by floods and erosion, whereas private ownership does not. Here is one:

The Wasatch National Forest includes critical watersheds above productive and well-irrigated farm land near Farmington, Utah. Most of this watershed land is publicly owned, but some of it was in private ownership for years and for years had been subject to fires, uncontrolled cutting of timber, and uncontrolled grazing by domestic livestock. These conditions induced frequent floods and mud flows. Rich farms and roads and highways were so badly damaged, and the normal flow of streams dwindled to a point where irrigation was so badly crippled, that part of the privately owned land was purchased by the community. Then, by request, it was added to the national forest. Now, under public ownership plus controlled use, the restored vegetative cover on this land is helping to restore normal stream flow, and protection to highways and farms.

Public regulation of cutting practices on private forest land may provide a better environment and more shelter for big game than unrestricted cutting of timber does. Judging from what has happened in many State forests—and on most national forests—public ownership and management of more forest land does provide more and better public hunting and fishing. Also more opportunities and more facilities for health-giving out-of-door recreation for many more people.

What has been accomplished by public ownership and controlled use on the Osceola National Forest is an outstanding example. It indicates what might be done in other parts of the South (p. 4) and elsewhere.

The Osceola is in Florida and includes 157,000 acres. It represents an investment of \$5 per acre in land, plus a few dollars an acre more in improvements to restore productivity and help to protect and develop its resources. After only 10 years of public ownership and management, this property has doubled in value. It now returns about \$50,000 annually in cash to the Federal Treasury. The 25 percent that goes to the counties each year is already in excess of the taxes received by the counties from the land before it was purchased. Management and controlled use of land, timber, and other resources now yield an annual pay roll in excess of \$125,000 and provide part-time employment for 470 people with 1,330 dependents. Indications are that, through a program of gradual improvement, this publicly owned national forest may some day yield \$250,000 annually to the Federal Treasury; that the pay roll—most of which comes from industries that use forest and other resources—may exceed \$1,000,000 annually.

Public Ownership and Management

Instead of trying to secure the greatest immediate profits for the few, the objective of public ownership and management of forest land is the greatest good to the greatest number of people in the long run. This includes the growing of timber for use and for revenue, but does

not stop there, on most community and State forests as well as on the national forests.

Community forests.—Sherburne, N. Y., has a village, a township, and a school-district forest. The first two were established and are managed primarily to help protect the water supply; the latter serves as a demonstration area for local owners of farm woodlands and as an outdoor workshop for younger generations. For 231 years the Newington, N. H., community forest has furnished lumber and timbers to help build bridges and keep up its school, church, parsonage, town hall, and library. The community forest owned and managed by Westfield, Mass., has been improved by planting more than three-quarters of a million young trees and, in the older stands, by improvement and thinning operations that yielded wood worth more than \$24,000 and provided worth-while work during 4 depression years.

Many community forests—including those owned and managed by Seattle, Wash.; Newman, Ga.; Virginia, Ill.; and Glen Falls, N. Y.—help protect and conserve local water supplies. Many have also put idle lands and idle hands to work again and have brought in revenue from recreational use, including summer or winter sports or both, as well as from the harvesting of timber and other products.

Active community-forest programs were initiated in many States during the year, and as a result many new units were established and many others planned.

State forests.—Posts used by its highway department are harvested from Connecticut's State-owned and State-managed forests. Controlled cutting operations that increase growth and improve the composition of the forest also yield lumber, timber, fuel wood, and charcoal. Permits are issued for the picking of wild berries, the gathering of laurel and witch hazel, the cutting of hay. Bathing beaches as well as campgrounds, parking areas, and other recreational facilities are developed. In 1940 Connecticut's 70,000 acres of State forests brought in approximately \$45,000. And year after year more than one-quarter of a million people use these public forests for recreation.

Emphasis is put on aesthetic and recreational values in Ohio's State forests, but carefully controlled improvement cuttings also yield forest products. New York's State forest preserves provide invaluable watershed protection and very much needed out-of-door playgrounds for people who live in congested cities. Washington has issued bonds to acquire more than one-half million acres of State forests. Under public controls that are similar to those in force on national forests, timber is cut on State-forest land in New Mexico. Flood-control projects are undertaken in Pennsylvania's State forests, where campgrounds and picnic-grounds are improved, summer-home sites are leased, forest products are harvested, millions of young trees are planted to make what was once idle land productive again, and a successful wildlife-restoration program makes better hunting and fishing available to the public.

National forests.—These publicly owned properties have been protected, developed, and administered by the Forest Service for more than 35 years. Like community and State forests, the national for-

ests are managed on that multiple- and regulated-use basis which is designed to assure the greatest combined benefits for the greatest number of people in the long run.

An acquisition program.—A summary of what these benefits are and of how the national forests are used is recorded later (p. 27) in this report. It indicates, as do many of the conditions and examples previously cited, the need for community, State, and Federal ownership and management of much more forest land.

How far this should go and how much forest land should be brought into county or State or Federal ownership should depend in part on the rate of progress in forest management on privately owned land. Present indications are that it would be good public policy to shift 140 to 150 million acres from private to public ownership, that communities and States should go as far as they can, and that the Federal Government should acquire and manage the rest. It should be noted, however, that this shift would still leave more than one-half of all the commercially valuable forest land in private ownership.

Public Regulation

In theory most Americans are opposed to regulation of what we think of as the rights of the individual and property rights. But most of us are practical. We realize that theory is one thing and practice is another. If we hunt and fish, most of us do so in season and with licenses. Most of us would object unless a permit were refused, even to the owner of the land, to build and operate a bowling alley or a rifle range alongside our homes.

We also realize the difference between theory and practice—and we demand the latter—when safety to children as they cross automobile-crowded streets on their way to and from school is at stake; when our families need protection against communicable diseases; and when, as a Nation, we are threatened by economic or military aggression, or both.

So although we cling, and properly so, to the right to protest against the way public regulation is administered, and to the inalienable right to argue for ways we believe to be better, most of us are glad that local, State, and Federal Governments are helping to protect our lives and our property. For we realize that we, as individuals, cannot do the job; that public regulation in many fields is now essential to the public welfare; and that it fits into the now-accepted framework of the American way of life.

This is true with respect to the public-regulation recommendation made by the Department and the Forest Service to the Joint Congressional Committee on Forestry.

With full appreciation for the many economic factors involved, this recommendation recognizes social implications and aspects as the crux of a Nation-wide situation that should be getting better for more people instead of worse for more; that should be contributing to higher standards of living for more people instead of lower standards of living for more of them.

The immediate aim of this recommendation is Nation-wide control of how privately owned forests may be cut if and as cutting takes place. It does not cover control over when the owner may or may not cut his timber, or over prices. But it does provide for public regulation rather than for regulation of industry by itself.

This, too, is in the public interest. For it just isn't in the cards for owners, most of whom are practicing destructive liquidation for maximum immediate profits, voluntarily to enforce adequate forest-cropping practices on themselves. Nor can voluntary self-regulation be expected to function in the face of such financial pressures and boom markets as have always led to quick liquidation of most of the privately owned forest resource.

Public regulation rather than self-regulation also fits into our democratic belief in fair play. Why should a few organized big men be given the power to regulate many unorganized little men in the same industry, or vice versa? Why should the people who need and purchase and use lumber and other forest products year in and year out, and who pay so large a share of the bills for fire protection and reforestation and erosion and flood control, have no direct voice in regulation or in how it shall be applied?

Nearly one-third of all our land is forest land. With a few exceptions here and there it is more valuable as such than it is for any other purpose. It can continuously produce raw materials and values and services that are vital now and, with the jobs they represent, will be still more vital during and after the post-defense period. So the Forest Service recommended to the Joint Congressional Committee on Forestry the minimum of Federal participation that it believed would redeem this responsibility, assure successful Nation-wide regulation, and provide ample opportunity for the States to formulate and administer State plans and for forest-land owners to prepare plans for cutting their own holdings and to participate in formulating forest-practice rules applicable to them.

Conditions have changed since this recommendation was made. Defense demands have led to greatly increased cutting in many forest regions. This is depleting privately owned virgin forests more rapidly. It is eating more rapidly into privately owned second-growth forests. Mostly destructive cutting, it is deteriorating the privately owned forest resource. It is a speeded-up repetition of the vicious cycle that has been too largely responsible for so many serious and widespread social and economic problems; problems like most of the worst of those rural slums that, still festering within territory that totals more than one-fourth of our land area, so seriously affect the lives and the outlook on life of millions of farm families and of thousands of others in rural villages.

There is, therefore, more need than ever for Nation-wide public regulation of cutting practices on privately owned forest land.

The Joint Congressional Committee On Forestry

THIS COMMITTEE was appointed at the request of the President in 1938. It held public hearings in every major forest region and in Washington, D. C. It recorded testimony of farmers, of industrial and other forest-land owners, and of many others. It studied and digested a huge mass of detailed information. On March 24 of this year its unanimous report was submitted to the Congress.

This report stresses the need for more public cooperation with and aid to private owners of forest land. But it also says:

The committee believes that private forest owners, particularly those who benefit directly from Federal funds, should—

(a) Change from the still too prevalent philosophy of liquidation to one of forest conservation. This is the basic need which will facilitate all other remedial measures and without which they can be only partially successful.

(b) Substitute for destructive cutting such partial cutting and other conservative practices as are needed to build up and permanently maintain the yield of commercial forest products at a much higher level.

(c) Adjust capacities of forest industries and plants to the sustained-yield capacity of accessible forests.

These statements are significant. So are the Committee's recommendations, for the latter stress the need for more State and Federal cooperation with and aid to farm and other private owners of forest land, but they do not stop there. They recognize that there is need for public ownership and management of more forest land by communities, States, and the Federal Government; and they give strong recognition to the principle of public regulation tied in with cooperative fire protection.

Work of the Forest Service

PART OF the responsibilities of the Forest Service as a public agency include: Gathering facts about the forest resource, about forest growth, forest depletion, forest protection, and trends in the use and management of forest land and forest resources; analyzing facts and trends; recommending measures that, in its judgment, are essential to protect the forest resource and the public interests and investments in it; and keeping the public, including forest-land owners, and operators, currently informed.

The Forest Service also cooperates in many ways with other Federal bureaus and agencies, with the States, and with farm, industrial, and other owners of forest land. It conducts research and makes results of it available to private owners as well as to public agencies. It plans and supervises work projects for the Civilian Conservation Corps; and it protects, develops, and administers the national forests.

In Defense

There are many ways in which the work of the Forest Service contributes directly to national defense. For example:

The Forests Products Laboratory studies the use of wood as a substitute for key materials like aluminum for airplane wings, fuselages, and propellers, and for ships and boats. It investigates housing, airplane-hangar, and other construction problems; the use of wood for plugs for naval shells and for gas-mask charcoal; its conversion to nitrating pulps and to chemicals, including antiknock compounds for gasoline. It does research in promising uses for impregnated and "compregnated" wood.

Wood so treated and processed becomes practically waterproof and will not warp, swell, or shrink. It can be compressed to one-third of its original size with attendant increase in its unit mechanical properties. It can be molded to have a surface nearly as smooth and hard as glass; and it can be pressed so that its density will vary from point to point as may be desired.

Among other contributions made by the Forest Products Laboratory are: Kiln-drying that, with no weakening of the wood, reduces the seasoning period of 3- by 14-inch aircraft spruce from 35 days to 15; redesign of a shipping container for bombs so that it uses less wood, weighs less, costs less, has greater strength, and requires less cargo space; and development of a high-yield semichemical pulping process which permits the substitution of "weed" hardwoods for more valuable species.

The Forest Service has detailed experts to train men in airplane factories; has investigated the volume, location, and availability of spruce to meet existing and immediately prospective requirements of the United States and Great Britain for airplanes; and has cooperated in the operation of conscientious-objector work camps on national forests.

Techniques for dropping equipment and men from airplanes to forest fires have helped in training parachute battalions. Arrangements have been made so that 3,200 lookout stations, 63,000 miles of telephone line, and some 3,000 radio stations in the national forests may if necessary be used for reporting the approach and movements of hostile aircraft. Ways and means have been worked out for giving additional protection against such forest fires, floods, and stream sedimentation as might endanger several important military and industrial areas or slow down defense operations.

Forest Service engineering personnel and equipment are building roads to tap new sources of strategic minerals. Maps, aerial photographs, relief models, and special equipment have been put at the disposal of military authorities. With help from the Bureau of Plant Industry, a list of trees, shrubs, vines, and grasses suitable for soil fixation and camouflage plantings has been compiled and is being used.

By transfer, the War Department now has title to 384,564 acres of what was formerly national-forest land in 2 States. Under special agreement it is using another 315,618 acres in 4 States and 1 Territory. It will soon have available 129,400 more acres in 4 States. The Forest

Service is also cooperating with the War Department in the purchase of more than 150,000 additional acres in or near national forests in 5 States; has made preliminary reports on some 30 special mountain-manuever areas; and is helping to meet the out-of-door recreational needs of people in military training camps and defense industries.

In Land Planning

The majority of Federal, regional, State, county, or community land-use-planning programs or projects involve important questions of forest-land use and management. The effectiveness of such planning work will depend in part on the availability of reliable factual data concerning forestry, and on adequate technical advice and cooperation in forestry fields.

To help meet this need, the Forest Service is actively participating in a large number of land-planning programs through membership in a wide range of committees and through the assemblage, interpretation, and presentation of essential factual data.

As a follow-up of the general report of the National Resources Planning Board on Development of Resources and Stabilization of Employment in the United States—a report which dealt with public works affecting land use—the N. R. P. B. requested the Department of Agriculture to assume leadership in the preparation of reports with special reference to agriculture. The Forest Service, with the cooperation of other bureaus of the Departments of Agriculture and Interior, prepared a report for the Board dealing with evaluation and programming of public works in the forestry field. It also cooperated in the preparation of somewhat similar reports in the land-use fields of recreation, range, and wildlife. These reports are under consideration by the N. R. P. B. but have not been released.

In Research

The Forest Service has directed research toward national defense, but also toward establishing and maintaining a healthier and more prosperous national economy after world peace is established.

Forest economics, including the forest survey.—Special information has been and is being obtained on the location, availability, amount, quality, price, and sufficiency of the supply of timber for defense and other purposes. Economic bases for selective logging in various forest regions have been and are being worked out. Practical measures to improve farm woodlands and the economic position of woodlands in the Nation's farm economy have been developed. Studies of the financial aspects of private forestry practices are under way in several forest regions. Forest-taxation studies have included local and State-wide problems bearing on taxation of privately owned forest land in Alabama, Mississippi, Virginia, Wisconsin, Oregon, and Washington. Further attention has been given to the question of payments in lieu of taxes on land in the national forests.

During the fiscal year 1941 all of Virginia and some 2 million acres in western Montana were inventoried by the forest survey, and 14 reports covering about 100 million acres were released. So were type maps for North Carolina, South Carolina, and one-fourth of Minnesota. To help improve hemispheric relations, a preliminary study was made of the significance of forests in our relations with Latin American Republics.

Forest products.—The Forest Products Laboratory is the only Federal organization exclusively devoted to technical and scientific work on wood and other forest products. Besides defense activities already mentioned (p. 20), it investigates such things as glues and techniques for using them under factory conditions; develops methods to preserve and protect wood and wood products. It makes strength tests on various woods and improves the structural performance of things made of wood. It seeks more effective utilization of domestic woods for pulp and paper and other products.

Forest influences.—With the Department's flood-control surveys, research in forest influences provides information that is essential to the control of streams within the flood plains of which are located fine farms, peaceful villages, and large cities—and vital defense industries, training areas, shipbuilding plants, and landing fields. This research is also concerned with problems and methods of preventing damage from erosion and sedimentation, and with methods of maintaining types and conditions of vegetative cover that will protect water for irrigation, for power, and for domestic use.

Forest management.—Standards of good forest practice have been and are being revised. Bases are being worked out for managing certain low-grade species and types that are now in demand because of the heavy impacts of defense on forest resources generally. Techniques and methods of detecting and suppressing forest fires are being revised and refined for peacetime use and adapted to defense needs. Experiments are being continued in nursery and planting methods and practices. Normal and defense demands that have brought accelerated exploitation of old-growth and second-growth forests are being studied. So are cutting methods and standards that—without in any way curtailing defense requirements—will make it possible to prevent unnecessary exploitation and leave the forest resource in better shape to meet post-war conditions and problems.

Range management.—Methods have been tested for making range surveys to develop better ways and means of using the forage resource. Among standards that have been formulated for more effective grazing are those for blue grama ranges in the Southwest, and highly important subalpine grasslands in the Pacific Northwest. In cooperation with the State experiment station, cattle breeding herds were maintained yearlong on annual plants growing on California foothill ranges. With supplemental feeding at critical times, calf production per breeding cow averaged 98 pounds heavier, and cows earned \$6 per cow more, than without such feeding.

Research and experience have shown that an increase in the number of livestock on national-forest ranges is not necessarily synonymous with an increase in meat production; that, on the contrary, an actual

increase in meat production often can be obtained more surely with fewer and better animals and less drain on the range resource.

With States and Private Owners

The Forest Service cooperates with the States and private owners of forest land in many ways.

In forest-fire protection.—To help safeguard forest land in private and State ownership from fire the Forest Service, acting for the Federal Government, now extends cooperative assistance to 41 States and Hawaii and, through them, to many private owners. About 3 million acres were added to the protected area during the calendar year 1940. This brings more than 281 million acres under organized cooperative fire protection, but there are still close to 146,750,000 acres that need it do not get it.

During the year 73,527 reported fires occurred on protected State and privately owned forests. They burned 2,934,054 acres. Damage was estimated at \$6,223,701.

The cost of supplying adequate protection to all State and privately owned forest lands is estimated to be approximately 18 million dollars. However, only \$9,027,442 was spent during the past calendar year. Of this amount, 75 percent was provided from public funds (52 percent by the States and 23 percent by the Federal Government) and 25 percent was provided by private owners.

Only about 3 percent of the 1940 fires reported from State and privately owned forest land were caused by lightning. The rest were man caused. Almost one-third of all fires were reported to be of incendiary origin; 26 percent were started by careless smokers and 18 percent had their origin in the burning of debris. But the evidence is clear that fires started by logging and other operations caused a much higher proportion of the damage than might be thought from these figures. This means that private operators, as well as the public, have a long way to go in the matter of fire prevention and fire suppression.

In farm-forest extension.—Cooperation in this field is among the Extension Service, the Soil Conservation Service, State agricultural colleges, various State forest and conservation departments, and the Forest Service. Its object is to help farmers solve problems having to do with the production and management of their farm woodlands and with marketing their forest products.

During the year ended June 30, 1941, 63 forestry specialists were employed in farm-forest work by 42 States and 2 Territories. More than 43,300 farmers made improvement thinnings and weedings in farm woodlands; more than 48,700 made selective cuttings; about 2,400 followed recommendations for marketing forest products; nearly 413,500 cooperated in preventing forest fires. In addition, 24,360 4-H projects were completed, and 17,600 result-and-method demonstrations were held.

In cooperative planting.—In addition to carrying on the shelterbelt project (p. 27), the Forest Service rendered assistance to and

cooperated with 42 States and 2 Territories in the production and distribution of forest planting stock during the calendar year 1941 when 87,468,000 forest-tree seedlings were distributed. These seedlings were sold by the States to landowners.

Through the Agricultural Adjustment Administration.—The Forest Service has advised with the A. A. A. in connection with forestry measures that are part and parcel of soil-building practices under the Agricultural Conservation Program. Practices now in effect are:

(1) Cultivating, protecting, and maintaining—by replanting if necessary—good stands of forest trees or a mixture of forest trees and shrubs suitable for wildlife; (2) improving stands of forest trees; (3) planting forest-tree seedlings or forest-tree nuts, provided they are given protection from fire and grazing and are cultivated in accordance with good tree-culture practices; (4) farm-woodland fire protection by the construction of firebreaks; (5) restoration of farm woodlands normally overgrazed.

Through the Farm Security Administration.—The F. S. A. has many loans secured in part by farm woodlands that, properly managed, could supply wood requirements for the farm and, from the sale of forest products, do much toward paying off the loans while at the same time building up—instead of deteriorating—the woodland resource.

During the past year the Forest Service lent the services of qualified men to draw up and test out a plan that might accomplish this. Results were so encouraging that the F. S. A. has made it possible for the Forest Service to (1) furnish pertinent information to—and train—F. S. A. personnel; (2) assist in bringing cooperation of other public forestry agencies and of certain forest industries to the F. S. A.; (3) assist F. S. A. clients on special forest problems; and (4) prepare forest-management plans for cooperatives that are financed by the F. S. A.

In forest farming.—The Forest Service directs forest-farming projects established as one result of the Cooperative Farm Forestry Act. To June 30, 1941, eight—including one each in Georgia, Florida, Louisiana, Texas, Alabama, New York, New Hampshire, and Maryland—have been placed under administration. Seven of them, State-administered, are financed on a 50-50 basis with the Federal Government. One is federally financed and administered.

Each forest-farming project serves as a demonstration area. It is in charge of a forester. He gives practical training in methods that will bring in greater incomes and at the same time conserve and build up the forest resource.

With commercial timberland owners.—Greatly increased cutting of forest products during the year augmented the need for cooperative projects with commercial timberland owners to improve their cutting and forest-management practices. It also caused a marked increase in requests for such projects but, although close to 300 owners were contacted, it was possible to establish actual projects with less than 5 percent of the owners who were in need of public cooperation and assistance. Projects established were in cooperation with State forest agencies wherever this was possible. In most cases personnel

and financial aid were contributed by the owner most directly concerned.

On the West Coast joint studies determined that most timberland owners were losing money on the smaller diameter trees they were cutting. In the Southeast continued progress was made by pulp companies in practicing improved forest management on their own lands, and in assisting other private owners to improve their cutting and management practices.

Naval stores conservation program.—The naval stores conservation program was authorized by the Soil Conservation and Domestic Allotment Act. Its over-all objective is better land-and-resource management in the naval stores belt in the South as a means to better social and economic conditions for some 50,000 workers and their dependents.

Specific provisions for participation in the program, which has been administered by the Forest Service since 1936, are that producers shall (1) discontinue the working of small trees; (2) limit the number of "streaks" placed annually on turpentine faces; (3) limit the height of turpentine faces; (4) provide better fire protection; and (5) adopt other approved methods which tend to conserve their timber resources.

With the Civilian Conservation Corps

A great deal of the work for which the Forest Service is responsible would have been impossible of accomplishment, for decades to come, except for the C. C. C. The record of this work, from camps on State forests, national forests, and privately owned forest land, of which there were 613 camps in 1941, is impressive. Since it is presented in the annual report of the Director, this record is not duplicated here.

Diversity of the work done by the C. C. C. on national forests, and the importance of that work in protecting, rehabilitating, and developing them and their resources, are indicated by the following:

Forest fires kept 22 percent of the enrolled strength of 34 camps on the jump for a 3-month period in Montana and northern Idaho. At Seeley Lake other enrollees built a camp—including 18 log cabins—for use by Boy Scouts, Girl Scouts, Camp Fire Girls, churches, and civic organizations. Experienced C. C. C. officials also helped the Immigration Service when some 800 alien seamen were interned at Fort Missoula.

Besides saving thousands of national-forest acres from fire, C. C. C. enrollees in Colorado and Wyoming and South Dakota have developed springs and water holes on summer ranges used by cattle and sheep; and have constructed many buildings for many purposes. At the Bessey nursery, on the Nebraska National Forest, enrollees have produced close to 30,000,000 trees since the C. C. C. was organized. They have also thinned plantations and protected them from insects, rodents, and diseases, as well as from fire.

The C. C. C. has increased planting on the national forests in the Lake States by 450,000 acres. Two C. C. C. companies have been

working on the Army's Annette Island air field in Alaska since August 1940. C. C. C. companies from more distant points helped others through the worst spring fire season New England has had in many a year. And depleted ranges have been reseeded; roads, trail telephone lines, and drift fences constructed; and public campgrounds developed by the C. C. C. on national forests in most States.

Estimates indicate that since May 1940 training, supervised by the Forest Service, has been given to some 100,000 C. C. C. enrollees in jobs that are vital to both industry and national defense.

On Special Projects

The Forest Service was represented on the intradepartmental committee which developed and recommended the oil and gas policy recently promulgated by the Secretary of Agriculture for all oil and gas resources under the jurisdiction of his Department. Among other special projects in connection with which the Forest Service has cooperated or which it has undertaken are:

Northern Pacific land-grant suit.—The December 16, 1940, decision of the United States Supreme Court in this case clarified the issues and supported the most important contentions of the United States, but remanded the case to the lower court for further proceedings. A new factor was introduced by the enactment of section 322 (b), part II, title III, of the Transportation Act of 1940, under which payment of full tariff rates to land-grant railroads was conditioned upon their waiver of all further claims under their grants. Both parties have now tentatively developed a proposed decree under which Federal title to the controverted lands would be freed of any cloud without any payment by the United States, the railroad company relinquishing other lands and making cash settlement for still other lands erroneously patented to the company. At the close of the fiscal year the proposal was under consideration by the Public Lands Committees of the Senate and House.

Administrative management.—During the year a study was made to formulate a better base for equitable distribution among regions of funds available for national-forest protection and management. It involved determination of manpower requirements at the certain levels of administration, based on correlation of time requirements for specific jobs. Results of the study indicate:

1. That all regions are underfinanced for the accomplishment of existing job loads at minimum acceptable standards.
2. That overloads are being met in part by regular personnel consistently devoting excessive amounts of overtime and by performance of certain classes of jobs at standards below reasonably acceptable minima. Both procedures are unwise.
3. That despite seasonal overloads excellent progress has been made in balancing work loads throughout the 12-month period.
4. But that, as emergency work programs decrease in size, additional regular funds will be needed to maintain existing fire-look-out structures, telephone lines, recreational facilities, and range and other resource and administrative physical improvements.

5. That this situation will not permit such adjustments in regional allotments of funds at their present levels as will provide adequate protection and administration of national-forest resources under the greatly increased public use already experienced and that now definitely in sight.

Hazard reduction in New England.—On June 30, 1941, the Forest Service and the States successfully completed reduction of the most serious part of the widespread fire hazard caused by the New England hurricane of 1938.

Final figures show that over 43¼ million man-days—including more than 3 million by the C. C. C.—were spent in clearing 10,079 miles of telephone lines, roads, and trails, and in disposing of brush on over 100,000 acres of State and privately owned land. There was additional work on water holes, towers, and telephone lines. Assistance was also rendered to town fire-control agencies by the States and the Forest Service.

The shelterbelt project.—The basic purpose of the shelterbelt project is to make portions of the Dakotas, Nebraska, Kansas, Oklahoma, and Texas more prosperous and better places in which to live. When this project was started in 1935 most farmers were skeptical. They have become convinced since then that these belts do grow rapidly, that they do conserve moisture, and that they give real and badly needed protection that could be obtained in no other way.

Approximately 2,700 miles of tree-and-shrub shelterbelts were planted on 4,700 farms during the 12 months ended June 30, 1941. The total to date is 16,100 miles on 26,375 farms.

Timber salvage in New England.—Up to June 30, 1941, the New England Timber Salvage Administration of the Forest Service had taken delivery of and paid for the equivalent of nearly 700 million board feet of timber from farm woodlands and other forest lands in six New England States that had been struck by the hurricane of September 1938. Some 275 million feet was reserved for local forest industries, and 160 million board-feet of it was sold to them in the fiscal year 1941. In addition, and after consulting national defense and other interested agencies, one contract of sale covering 425 million feet—at prices adjusted to market values every 90 days—was made. The purchaser had taken approximately 70 million feet by June 30, 1941.

The National Forests

THE NATIONAL forests and their resources and services belong to all the people. On June 30, 1941, with their purchase units, they included 177,497,531 acres owned or in process of acquisition by the Federal Government within 42 States and 2 Territories.

Acquisition of Land

The Weeks law provided \$1,000,000 for land acquisition during the fiscal year. Even with the \$71,000 of national-forest receipts that was

also appropriated for acquisition, the total was below that available in recent years. This reduced the rate of progress in consolidating and extending national forests. Progress was made, however, through donations and exchange as well as through purchases.

Through purchases.—The National Forest Reservation Commission approved the purchase of 195,818 acres at a cost of \$805,479 during the year. The greater part of the land is cut over, but most of it supports fair to excellent stands of seedlings, saplings, or poles. Among tracts that support stands of quality saw timber are: The Cox Grove in Indiana, which is to be preserved intact for research and related purposes; 1,210 acres of redwood in California; 1,644 acres in Louisiana; 543 acres in Texas; 1,936 acres in Michigan; 1,050 acres in Maine; and, in Oregon, 2,000 out of 12,732 acres that were purchased from the United States Spruce Corporation.

The total net area approved for purchase to June 30, 1941, was 17,980,000 acres, costing \$67,560,474. That actually vested in Federal ownership was 17,558,928 acres, costing \$65,969,440.

Through exchanges.—Through 174 exchanges consummated during the year, the United States acquired 290,112 acres, valued at \$1,853,215; gave in exchange 50,176 acres, valued at \$175,339, plus 444,417,000 board feet of national-forest stumpage, valued at \$1,052,098. By exchanges, the net increase in national-forest acreage was 239,936.

The Secretary of Agriculture also approved and referred to the Secretary of the Interior or to the National Forest Reservation Commission 237 other exchanges through which, if they are consummated, the United States will acquire 322,287 acres, valued at \$1,716,763, in exchange for 23,127 acres of national-forest land and 520,590,000 board feet of stumpage.

Exchanges in Michigan involve land in State forests purchased by the United States with intent to exchange it for State land in national forests. The State has acquired 157,170 acres, valued at \$484,525; the United States, 173,175 acres, valued at \$487,972. With these exchanges both public properties are better consolidated and the management and development of them are more efficient and economical. The same principles and procedures apparently could be applied in numerous other States effectively and with mutual satisfaction.

Through donations.—During the fiscal year 44 tracts, aggregating 39,404 acres, were donated. Of these, 26 tracts, containing 957 acres, were to aid national-forest administration, while 18 tracts, containing 38,447 acres, were to promote timber production, watershed protection, and allied purposes.

Boundaries and Status

The following is a summary of major changes made in national-forest boundaries and in public-private ownership of land during the year ended June 30, 1941.

By eliminations.—Under congressional authority, the Secretary of Agriculture transferred a net area of 64,328 acres within the De Soto National Forest, Miss., to the War Department for national defense. Under Executive orders issued by the President, 11,079 acres were eliminated from the Chugach National Forest, and 143 acres from the Tongass National Forest, Alaska, mostly for townsites and homesites. Pursuant to the act of July 9, 1937, 8,207 acres were eliminated from the Stanislaus National Forest and added to the Yosemite National Park, Calif. The net elimination of national-forest lands was 83,757 acres.

By additions.—Through congressional action 67,917 acres of purchased lands within and adjacent to the Siuslaw National Forest Oreg., were given a national-forest status. By proclamation, 200 acres and 59 acres of public domain were added to the Shasta National Forest, Calif., and the Wenatchee National Forest, Wash., respectively, and 720 acres, formerly a part of the Pine View Lake Reclamation project, was included within the Cache National Forest, Utah. The Boston Mountain project, of 87,944 acres, was added to the Ozark National Forest, Ark.; and 18,220 acres previously acquired by purchase under title III of the Bankhead-Jones Act became parts of the Chattahoochee National Forest, Ga., the Talladega National Forest, Ala., the Appalachian National Forest, Fla., the Ouachita National Forest, Ark., and the Nicolet and Chequamegon National Forests in Wisconsin. After agreement between the Tennessee Valley Authority and the Department of Agriculture, the President added 6,197 and 680 acres that had been previously been acquired by the Authority to the Chattahoochee and Cherokee National Forests, respectively.

In Montana 53,152 acres were transferred by Executive order from the Lolo to the Helena National Forest to facilitate administration. In New Mexico 11,168 acres of the Fort Bayard Military Reservation were transferred to the Public Buildings Administration of the Federal Works Agency and placed under the custody of the Forest Service for administration and protection with adjoining lands of the Gila National Forest. The Wyoming National Forest, Wyo., was renamed the Bridger National Forest in honor of the man who was so long associated with the early exploration and development of the region in which this forest is located.

The net increase in national-forest acreages resulting from Proclamations and Acts of Congress was 140,229 acres. The gross increase amounted to 125,622 acres. The difference in these figures is due to the fact that the major part of the lands added to the forests was inside existing national forest boundaries.

Memorial forests.—By Executive order, the President designated lands within the Massanutten Unit of the George Washington National Forest, Va., as the Robert Fechner Memorial Forest in honor of the first Director of the Civilian Conservation Corps. To mark the four hundredth anniversary of the discovery of the Mississippi, the Forest Service recommended, and the National Forest Reservation Commission approved, the establishment of a Forest of Discovery along the banks of the river in western Tennessee.

Protection

TIMBER and many other values on national forests are subject to damage and destruction by fire and by insects and diseases, and must be protected from them.

Fire Protection

Protecting the national forests from fire involves, among other things, preventing fires, preparing for those that start, and suppressing them.

Fire prevention.—Study of problems involved in man-caused fires was continued by the Advisory Council on Human Relations in cooperation with field officers and the psychologist employed by the Forest Service. A special fire-prevention meeting was held at Elkins, W. Va., in cooperation with that council. Current educational material received a thorough overhaul. More emphasis was placed on law enforcement as a more effective instrument of fire prevention.

Preparedness.—Since the experienced fire-control personnel has been weakened by the increasing diversion of men to military and industrial fields for defense, every effort was made to recruit new manpower, and more emphasis was placed on preseason training.

Estimates were worked out, by regions, for the direct expenditures that are necessary adequately to protect the national forests from fire. Coordination of these estimates brought new understanding of the economics of fire control. Past fire damages have been studied and forecasts of future trends made in order to relate expenditures more closely to the varying probabilities of fire danger.

Fire suppression.—Parachute jumping of men to forest fires in remote territory was expanded. After training, three squads of jumpers were placed at strategic points to serve certain remote forested zones in Washington, Montana, and Idaho. The "40-man crew method" of suppression was extended, particularly in the Pacific Northwest. Continued improvement in the methods of progressive line building resulted in increased speed in construction of held fire line. Fire control tools, instruments, and mechanical equipment were further improved.

The record.—The calendar year 1940 witnessed an unprecedented number of lightning fires in Montana and Idaho, with severe lightning storms in the Pacific Northwest and in Arizona and New Mexico. Of the 17,053 fires fought by the Forest Service during the calendar year, 8,902 were caused by lightning. This compares with 7,269 in 1939. The total area of national-forest land burned was 228,364 acres. The total damage on national-forest land is estimated at \$937,175.

Although the total number of fires was greater than in any previous year, the number of man-caused fires was reduced from 8,555 in 1939 to 8,151 in 1940.

Insect and Disease Control

Insects.—On national forests, destructive outbreaks of beetles continued in lodgepole pine stands in Utah, ponderosa pine in Oregon, and western white pine in northern Idaho. Localized attacks occurred in South Dakota, Colorado, and California. Altogether it was necessary to treat 61,400 trees on 455,600 acres.

This work, done in close cooperation with the Bureau of Entomology and Plant Quarantine, involves felling the trees and destroying the immature insect broods by fire or otherwise. A promising recent cooperative development is the use on infested trees of thin-barked species of a penetrating spray which kills the insects. This reduces labor requirements and eliminates hazardous burning.

Diseases.—White pine blister rust control work continued during the year on national forests in the southern Appalachians, the Northeast, the Lake States, eastern Washington and northern Idaho, and in the sugar-pine region of California and southern Oregon.

The situation is most critical in the Washington and Idaho, and the California-Oregon regions just mentioned. Here the rapidly spreading disease must be controlled on 2,556,000 acres to prevent the destruction of reproduction and young trees of western white and sugar pines.

In close cooperation with the Bureau of Entomology and Plant Quarantine, initial control measures were applied on 40,000 acres in the West during the year. To date, such measures have been applied on a total of 1,349,000 acres. Including reworkings, about 126,000 acres was covered during the year.

Control work consists of eradicating ribes bushes within and near threatened timber stands. Studies indicate that about 70 percent of the control area usually requires two workings; only about 40 percent requires three. These retreatments, necessary to protect investments in initial control, reduce the amount of new work which can be done with funds which have been available lately. So do recent decreases in available C. C. C. and W. P. A. labor. The disease is spreading rapidly, and there are still 1,207,000 acres that must be treated initially.

Development and Administration

DURING an informal talk to a group of young foresters when he was President, Theodore Roosevelt once said, in part, that

. . . the primary object of our forest policy, as of the land policy of the United States, is the making of prosperous homes. . . . The whole effort of the Government in dealing with the forests must be directed to this end, keeping in view the fact that it is not only necessary to start the homes as prosperous, but to keep them so. . . . You can start a prosperous home by destroying the forests, but you cannot keep it prosperous that way . . .

The Forest Service has kept this thought constantly in mind while developing and administering the land and its resources—including

water, timber, forage, wildlife, and recreational opportunities—on the national forests.

Land

Accurate surveys and maps and an adequate system of highways, roads, and trails, are essential to planned use of the national forests.

Maps and surveys.—Maps are generally prepared from aerial pictures that also serve in such activities as fire control, range surveys, and determination of the distribution and density of timber. Aerial-photographic coverage of 21,865 square miles was obtained during the year. Planimetric maps were prepared from pictures for 19,030 square miles. Topographic maps made by ground methods totaled 638 square miles. These maps conform to standards of the Federal Board of Surveys and Maps, and are published on scales of $\frac{1}{4}$, $\frac{1}{2}$, and 1 inch to the mile.

Highways, roads, and trails.—Protection, plus greatly increased demands for timber, minerals, and other resources that are vital both for everyday use and for national defense, have required increases in the planned transportation system for the national forests.

It now includes some 24,300 miles of forest highways, 123,500 miles of development roads, and 163,800 miles of foot and horse trails. As of June 30, 1941, approximately 51, 54, and 31 percent, respectively, of this planned system were either nonexistent or on unsatisfactory standards. With the limited funds available, the mileage of highways constructed during the year just about kept pace with the mileage of proposed highways that were added to the planned system. Work on truck trails and trails did not. It is estimated that, even with four times the average of the last 5-year appropriations, it will take 50 years to complete the transportation system as now planned.

Claims.—There were 36 final applications for homesteads in the national forests during the fiscal year 1941. Favorable reports were made by the Forest Service on 20 of them; unfavorable reports on 7. The balance, 9, were still pending at the close of the year. Action during the year also involved 201 mineral claims. Of these, 87 were reported favorably, 18 unfavorably, and 96 were pending at the end of the year.

Special uses.—During the year the Forest Service issued 6,621 permits for the use of land for such purposes as pastures, railroads, summer and winter resorts, apiaries, airports, roads, and telephone lines. Each tract was so located that use of it did not interfere with land-and-resource management for the public. The total number of such permits in force was 44,010. Of these, 19,711 were free, and payment was required for 24,299. Revenue from them to the Federal Treasury was \$383,752.47.

Water

Forest and other vegetation on watersheds is nature's method of regulating water flow, of maintaining the favorable qualities of water, and of extending its usefulness.

In part because of the forest fires and forest exploitation and deterioration on privately owned land, but in larger part because of the expanding requirements of a growing nation, we now need more regulation of water flow than can be provided by the influence of vegetative cover alone. Even so, well-maintained forest and other vegetative cover on watersheds reduces costs of operating, maintaining, and replacing reservoirs, canals, pipe lines, and spreading grounds, for example. And where impoundments are not employed, the regulating function of vegetation becomes increasingly important to minimize the height and damage of floods, to reduce the length of periods of low-water flow, and to maintain water quality.

Flood control.—The flood-control survey of the Los Angeles River watershed in southern California resulted in the establishment of a remedial program. That part of the program which relates to the mountain section was approved for Forest Service operation, and \$1,170,500 was allotted to the Forest Service to undertake the unified mountain watershed program in the Arroyo Seco subdrainage, most of which is on the Angeles National Forest. The program to be carried out here is divided into four major work classes: Fire control, vegetative-cover improvement, road improvement for erosion prevention and control, and mountain-channel improvement. Construction is under way in the fire-control and road-improvement phases. Engineering exploration, site surveys, and designs for the channel-improvement program have advanced to a stage which should permit construction in the fall of 1941. The cover-improvement program must wait the rains of the winter season. Active cooperation in the Arroyo Seco program has been assured by the Los Angeles County Flood Control District and the California State Highway Department, the cities of Los Angeles and Glendale, and Los Angeles and Ventura Counties. The mountain program to be carried out by the Forest Service on the Los Angeles watershed will amount to approximately 7 million dollars.

To prevent damage by erosion, sedimentation, and possible floods from a 8,800-acre area burned in August 1940 in the San Bernardino National Forest, in southern California, approximately \$132,000 was expended for emergency measures. These included sowing mustard seed to develop a temporary vegetative cover crop that would help retard erosion; roadside stabilization and erosion-prevention measures; channel clearing; and the construction of two debris basins and dike to protect local values. Emergency action for similar purposes was provided in several additional areas, and many simple stream structures were built by the C. C. C.

Power permits and easements.—On the national forests there are 49 active permits and easements that were issued by the Forest Service prior to the enactment of the Federal Power Act—and are still in force—for operation of hydroelectric and transmission-line projects. At the end of the 1941 fiscal year annual rental fees were being charged on 43 power projects and 63 transmission-line projects. The Forest Service was supervising the operation of 447 Federal Power Commission permits and licenses at the end of the year. Of all applications received by the Federal Power Commission from all

sources during the year 82 percent, or a total of 107, involved the use of national-forest land or Forest Service administration or both. Forty percent, or 43 applications, were for rural-electrification projects.

Timber

The fiscal year 1941 witnessed an all-time high in the value of timber cut from the national forests, and activities in connection with national defense caused such an upward trend in the demand that—because of lack of sufficient manpower and funds to handle new sales—it was again impossible to sell all the timber and other forest products for which applications were received.

National-forest timber-sale business is by no means confined to the sale of sawlogs. Many other forest products also provide work. On the Francis Marion National Forest in South Carolina, for example, cull trees and scraps left from logging operations are sold at nominal prices to local residents. They transform this forest waste into charcoal, for which there is a ready local market. And on the Deschute National Forest, Oreg., an enterprising sawmill operator is purchasing and sawing ponderosa pine trees that have been killed by bark beetles or other causes, thus reducing the fire hazard as well as using material which would otherwise rot in the woods.

Timber sold.—Of the 25,553 commercial and cost sales of national forest timber and timber products made during the fiscal year, 23,043 involved timber valued at \$500 or less. These family-size sales cost more to administer than larger ones, but they are often vital to the welfare of local residents and communities (p. 14).

All sales of timber on all national forests last year involved stumpage equivalent to 1,464,523 M board feet. The volume involved in land exchanges was equivalent to 527,711 M board feet. Receipts from sales of timber and other forest products, and as settlement for timber trespasses, totaled \$4,789,024. In addition, timber worth \$1,232,920 was cut in satisfaction of land exchanges, and dead and down trees and other material were furnished free of cost to settlers to the extent of about 284,228 M board feet.

Timber harvested.—Located close to centers of industry and population, eastern and southern national forests contributed a cut equivalent to 243,686 M board feet of timber which had a stumpage value of \$1,314,899. This contribution, which should increase as new crops of managed timber are harvested, testifies to the wisdom of the Congressional action that initiated the forest-acquisition program some 30 years ago.

The total timber cut from all national forests during the 1941 fiscal year amounted to 2,067,279 M board feet. This favorable showing was made possible in part by a deficiency appropriation of \$50,000 which was made by Congress specifically for timber-sales administration.

Planting.—With 147,102 acres planted during the year, the national forests now contain over a million acres of plantations after eliminating losses due to droughts, fires, and other causes.

Most of this was land that had been burned over before being administered as part of a national forest but, especially east of the Great Plains, some was land that had been cleared for farming, cultivated a few years, and then abandoned. A smaller amount represents the unusual conditions under which, in order to be sure of getting a new crop of desirable kinds of trees promptly, the old timber was cut clean and the land planted.

In the national forests there is about three times as much land that still needs planting as has been successfully planted to date. More than two-thirds of it is east of the Great Plains. There will be still more as acquisition of cut-over privately owned land continues.

Nurseries.—Of 26 nurseries operated primarily to furnish young trees for national-forest planting, 17 are in eastern regions. Both East and West, curtailment of nursery and planting work may be necessary as the number of C. C. C. camps decreases. Contractions and expansions must be carefully planned, however, because seed must be collected and trees grown—all of which takes time—long before field planting operations can be undertaken.

Forage

Most of the forage on national forests occurs in combination with timber and on higher portions of watersheds. Some of it is used by big game, but in the West, particularly, more of it is converted into millions of pounds of beef and mutton through the grazing of domestic livestock. Good management of forest ranges is, therefore, assurance of economic support for many communities and thousands of families. Through them it adds materially to the national wealth.

To be as effective as it should be, management of most national-forest ranges involves, among other things, adjustment of use as between big game and domestic livestock; better distribution of both of them; development of water; the construction of drift and other fences; and revegetation and protection of depleted areas.

Properly applied, all these measures not only act as safeguards against further depletion of the forage resource, but they also help restore ranges that are still subnormal largely because (1) they were deliberately overstocked to help meet demands during World War I; (2) big game has increased; (3) ranges have also suffered during protracted periods of drought; and (4) reductions in overstocking, successful in part, have generally been made slowly in order to allow more time for readjustment by many stockmen who have been in distressed circumstances.

Better management of national-forest ranges also involves control of rodents; eradication of poisonous plants; control of trespassing stock; the making of range surveys; and cooperation with stockmen through their local, regional, and national associations.

Rodent and poisonous-plant control.—Rodent control was applied to approximately 2,206,500 acres of national-forest ranges in 1940, but there are still more than 6,622,300 acres that need it. In efforts to

eradicate poisonous plants, 2,570 acres were treated. Control operations were applied only to critically infested areas.

Trespass.—Reported as being in trespass on western national forests during 1940 were 17,090 cattle and horses, 65,065 sheep and goats, 3,281 wild horses, 81 swine.

Losses.—In Western States poisonous plants accounted for the death of 4,006 cattle and horses and 26,492 sheep and goats during the year. Predatory animals killed 943 cattle and horses and 67,280 sheep and goats. Disease was responsible for the loss of 2,204 cattle and horses and 12,397 sheep and goats. Other causes contributed to a loss of 6,537 cattle and horses and 46,167 sheep and goats.

Range surveys.—Intensive surveys covered 43,530,000 acres. Most of this work was done by a combination of aerial-photography and ground-crew methods.

Stock use.—Except in Alaska, only about half of the national forest land west of the plains region is used by domestic livestock. During 1940, 18,906 pay permittees grazed 1,147,539 cattle, 29,421 horses, and 184 swine; 5,083 pay permittees grazed 4,943,131 sheep and 6,065 goats. In addition, 23,273 owners grazed 71,335 cattle, 47,551 horses, 17,565 swine, 15,554 sheep, and 3,551 goats under the regulations granting free use to local dependent settlers and experimental or research institutions.

Thus national-forest range provided forage during 1940 for 1,218,874 cattle, 77,011 horses, 17,749 swine, 4,958,685 sheep, and 9,611 goats. Computed on the basis of use by 1 cow for 1 month, this equals 10,896,149 animal-months.

Reductions.—Reduction of 42,941 cattle and horses, and 183,321 sheep and goats, from the numbers grazed in 1939, was made in 1940.

Cooperation.—The Forest Service cooperated with 767 stockmen's associations, most of which include advisory boards that function in the management and administration of national-forest ranges. Twenty-one new associations and 2 new State advisory-board groups were formed during the year.

Wildlife

The Forest Service considers wildlife as a renewable resource that can and should be cropped under such management as will perpetuate it and at the same time contribute to human happiness and well-being and to the care and planned use of land, water, forests, forage, and other vegetative cover. Upon this basis, and with full recognition of biological factors, the Forest Service cooperates with the respective fish and game departments of the many States in which national forests are located in the management of the big game, fur bearers, fish and other wildlife on the national forests.

In addition to fish in thousands of streams, lakes, ponds, and reservoirs, the national-forest-wildlife resource includes—by way of example—elk, deer, and antelope; turkey, grouse, and quail; beaver, marten, and fisher; mountain lion, wolf, and coyote; a host of small-game animals, fur bearers, and water fowl; and a rich fauna of birds, small mammals, and other lower forms of animal life.

The Forest Service has actively encouraged the development of wildlife resources on national-forest land since 1906. Bison were established on what is now the Wichita National Game Preserve in 1907, and elk planting began later on certain western forests. Since 1908 big game has doubled every 10 years and has now reached a total of 100 million on national forests of over 2,000,000, or nearly 6 big-game animals per square mile of the gross area. The increase last year was as marked as in any previous year. One-third of all big-game animals in the United States is on national-forest land all or part of the year. In addition to big game, over 7 million fur bearers and 5 million upland game birds live on national-forest lands.

A new wildlife manual will help guide forest officers in administering wildlife on the national forests in cooperation with the States, and in establishing responsibilities and priorities of wildlife activities. It provides a broad basis for such cooperation and management as would assure the perpetuation of breeding stock. It also recognizes wildlife as a major resource, is broad enough to permit the setting up of plans adapted to local needs and conditions, and to assure the greatest benefits to the millions of people who use the national forests for public hunting and fishing grounds each year.

Recreation

National Forest Vacations, published during the year, gives a general statement about these public properties and an over-all picture of the various forms of summer and winter recreational opportunities they offer. There is also a convenient listing of all the national forests by name and location, together with thumbnail sketches of special features and the types of accommodations available.

Recreation areas, types of recreation, and recreational facilities.—The national-forest recreation system now includes 2,300 campgrounds, 572 picnic areas, 1,381 recreation areas for both camping and picnicking, 254 winter-sports areas, 54 organization camps, and 11 resorts that have been developed or constructed for the enjoyment, convenience, and safety of the public.

Relatively simple facilities include stoves or grates, tables, good drinking water, and sanitary conveniences at all improved campgrounds and picnic grounds; simple shelters, bathhouses, playfields, and nature trails at some of the more popular ones; with parking areas, ski shelters, runs, and jumps, and some toboggan slides on winter-sports areas.

Organization camps, built to provide an opportunity for low-cost vacations to people of modest means, are equipped with bunkhouses, mess halls, recreation halls, and other structures. Public-spirited organizations usually sponsor vacations to these camps for groups at a cost of about \$5 to \$7 a week per person. This includes food, lodging, and transportation.

Recreational use.—In general recreational uses of national-forest lands are free and restrictions are kept to a minimum. But in the interest of safety to life and limb, as well as to protect forest and

other values, it is sometimes necessary to require camping parties on the national forests to include an ax, a shovel, and a waterbuck among their equipment. In 1940 it is estimated that close to 16,163,000 visits were made to the national forests to camp, picnic, swim, fish, hunt, hike, or ride, or to spend some time in summer homes or resorts located in the national forests, or to take advantage of the excellent opportunities offered for skiing, tobogganing, and other winter sports. In addition, more than 22,270,100 visits were made by sightseers and persons seeking relief from the climate.

Fiscal

EXPENDITURES by the Forest Service during the fiscal year 1940, \$12,949,295 less than during the previous one, totaled \$63,454,930. They included: Cooperation with States and private agencies in fire control, planting, and forestry, \$2,344,815; contributions for fire control, slash disposal, improvement work, etc., \$3,334,234; hazard reduction and fire control following the hurricane in New England, \$794,928; work relief, including C. C. C. expenditures for camps on State and private lands, on national forests, and on lands controlled by certain other Government agencies, \$26,846,563; research, \$2,141,109; other Government agencies, \$1,149,400; and miscellaneous, \$605,799. Expenditures for the protection, management, development, and extension of national forests were \$26,238,091, of which \$5,477,840 was made by the Public Roads Administration for forest highways, and \$2,362,253 was for the acquisition of additional National-forest lands.

Forest Service funds, derived from 48 appropriations, were allotted to units and subunits and accounted for by appropriations, objects, and purposes. Independent audits extended to regional offices, experiment stations, the Forest Products Laboratory, the shelterbelts, and New England projects, national-forest offices, ranger districts, State C. C. C. offices, and C. C. C. camps under Forest Service jurisdiction.

Use of expended funds in connection with individual resources was reflected by 40 major expenditure-accounting captions. With project cost records, they supplied data for administration and for the Secretary, the Bureau of the Budget, Congress, and other agencies.

Net receipts from the national forests during the fiscal year were \$6,681,825, of which \$1,568,754 was, under existing legislation, returned to the States.

New Legislation

ACTS OF the last half of the Seventy-sixth and the first part of the Seventy-seventh Congress which were passed during the 1941 fiscal year, and which affect the work of the Forest Service are as follows:

Appropriation Acts

Act of July 1, 1941 (Public, No. 144), making appropriations for Department of Agriculture for fiscal year 1942.

Act of July 1, 1941 (Public, No. 146), making appropriation of \$246,960,000 for the C. C. C.

Act of July 3, 1941 (Public, No. 150), making appropriation of \$1,100,000 to intensify and augment cooperative forest-fire prevention and suppression in critical areas.

Act of April 1, 1941 (Public, No. 25), making deficiency appropriations, includes \$3,480,000 for fighting and preventing forest fires and \$50,000 additional for forest protection and management, fiscal year 1941.

Act of July 1, 1941 (Public, No. 143), making appropriations for work relief and relief for fiscal year 1942.

Act of October 9, 1940 (Public, No. 812, 76th Cong., 3d sess.), making supplemental appropriations, includes \$125,000 for reconstruction and repair of national forest roads and improvements in Georgia, North Carolina, South Carolina, and Tennessee damaged or destroyed by floods.

Other Acts

Act of November 25, 1940 (Public, No. 877), authorizing addition of lands to the Siuslaw National Forest, Oreg.

Act of September 5, 1940 (Public, No. 780), authorizes the acquisition by the States of scenic roadside strips.

Act of September 18, 1940 (Public, No. 785), under which the Northern Pacific Railroad suit will be settled.

Honor Roll

DESPITE pretraining of forest workers, eternal vigilance, and leadership by men of experience and judgment, the honor roll for the year ended June 30, 1941, includes the names of 13 men who, while employed by or for the Forest Service, lost their lives on fire-flung fire lines or because of forest fires.

The five from the Civilian Conservation Corps were: Arthur Bowman, foreman of Company 1452, and William T. Ingle, enrollee of Company 6418, both of whom were hit by falling trees on the Mount Hood National Forest, Oreg.; Joseph C. Galluzzo, enrollee of Company 2526, and H. Cox, enrollee of Company 3538, who died on the lines on the Boise National Forest, Idaho, and in West Virginia, respectively; Tom Teston, an enrollee of Company 3442, who was fatally injured when a truck in which he was riding failed to make a sharp turn successfully.

The eight others were: Herbert J. Cook, foreman, who died from a heart attack while directing a fire-fighting crew on the Bighorn National Forest, Wyo.; John Tomisser, whose heart apparently failed while he was fighting fire on the Chelan National Forest, Wash.; Carl J. Hanson, William Von West, August T. Schultz, and Loren Appleby, who were killed by falling trees while fighting fires on the Idaho National Forest, Idaho, the Wasatch National Forest, Utah, the Willamette National Forest in Oregon, and the Bitterroot National Forest,

Mont., respectively; William F. De Avilla, whose skull was fractured at a fire on the Klamath National Forest, Calif., and who died later and Robert Moricich, a pilot from Missoula, Mont., who lost his life in the crash of an airplane.

Statistics

THE PRACTICE of compiling certain basic statistical material in tabular form, and making it available separately from the annual report rather than as a part of it, is continued. Section 22 of Volume X, Administrative Statistics, is multilithed, and copies may be obtained on request from the Forest Service, Washington, D. C.

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Forestry in Wartime

REPORT OF THE CHIEF OF THE FOREST SERVICE, 1942

UNITED STATES DEPARTMENT OF AGRICULTURE,
Washington, D. C., September 15, 1942.

DR. CLAUDE R. WICKARD,
Secretary of Agriculture.

DEAR MR. SECRETARY: Under the stress of war the Forest Service has been called upon for many new and challenging tasks. Intensive forest-fire protection has become an important element in national defense. The forest-fire lookout network has been made a major feature of the Army's air-raid detection system. Large-scale production of guayule rubber is under way in California. A program has been inaugurated to obtain supplementary supplies of aircraft fuel from Alaska. Substantial contributions to the design and construction of wooden aircraft have been made. Problems in boxing and crating of supplies and equipment for the armed forces and our allies are being solved. Analyses of supplies, production, and requirements are aiding in planning and stimulating the output of forest products. The volume of timber cut from national forests has been stepped up to 70 percent above the 1939 level. These are some of the ways in which the facilities and technical knowledge of the Forest Service have been made to serve in the war effort. Wartime demands for forest products highlight the Nation's forestry situation. Mounting requirements for lumber have been estimated at 6 billion board feet in excess of prospective production in 1942.

Pressure to supply demands has been reflected in a new wave of destructive cutting sweeping over the second-growth forests of the West and eating further into the old-growth stands of the West. In some cases this new wave is turning back the clock of good practices by private owners.

Uneconomic stripping of immature timber does not make efficient use of available manpower and equipment. Failure to conserve a nucleus of productive growing stock may prove disastrous to many forest communities and landowners, particularly the smaller and more needy. Through the heat of war, the future welfare of owners, workers, and industries dependent upon the forests must not be unnecessarily jeopardized by indiscriminate clear-cutting when volume of production can generally be maintained equally well under good forest practices.

With ample unused mill capacity the difficulties being encountered in regaining the level of lumber production which prevailed in the years prior to 1929, reflect to no small degree the depletion and deterioration of forests throughout the country. When we are forced to obtain 40 percent of our lumber production from the Pacific Coast States, problems of manpower, equipment, and transportation become more acute than would be the case if lumber cut could be more evenly distributed over other sections.

Rising stumpage prices present further evidence of the pinch depleted forest growing stocks in many sections. We are reaping the fruits of decades of apathy toward our basic forest problem.

The Forest Service believes that the most essential wartime requirements can be supplied if aggressive action is taken to stimulate and coordinate production. It is collaborating actively with the War Production Board, the Office of Price Administration, and the military establishments to this end. But it is deeply concerned about the widespread use of destructive cutting methods which unnecessarily undermine future forest productivity.

Developments in less than 1 year of war bring sharply into focus the inadequacy of the Nation's present forestry effort and the threat to the security of rural people throughout our forest regions which is inherent in the current situation. Comprehensive action along the lines repeatedly recommended in annual reports of recent years with Nation-wide regulation of cutting practices on private forest lands as a salient feature, should no longer be postponed.

Sincerely,

Paul H. Clegg

*Acting Chief,
Forest Service.*

FORESTRY IN WARTIME

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FOREST RESOURCES AND THE WAR

PRODUCTION FOR WAR HANDICAPPED BY PAST NEGLECT OF OUR FORESTS

THE NATION'S FORESTS are being called upon for a tremendous output of materials essential to the war effort. Billions of feet of lumber are needed to house the expanding American armed forces and the growing army of workers in war industries. Wood and wood derivatives are needed for ships, wharves, airplanes, gunstocks, explosives, and a host of other war materials and facilities. Some 8 billion board feet of lumber is the estimated 1942 requirement for boxing and crating war materials, agricultural products, and essential civilian goods. Orders for Army beds will call for from 30 to 40 million feet of hardwoods this year. A million feet a day will be needed for Army truck bodies.

Wood in 1942 was classed as a critical war material. The War Production Board issued an order freezing supplies of softwood construction lumber for immediate war uses. Increasing difficulties were experienced in finding high-quality timber needed for a number of specialty uses.

In the face of mounting requirements for war use, total lumber production in the United States in the first half of 1942 decreased

some 5.4 percent as compared with the corresponding period of 1941. A number of factors contributed to the decline in production—weather, equipment and labor shortages, transportation difficulties, financial uncertainty. Yet back of all this is the fact that our Nation has allowed much of its forest land to deteriorate.

Our tolerance of destructive liquidation over the years means that we no longer have abundant saw-timber supplies accessible throughout the country. We now have to search out isolated remnants of timber for specialty uses. For timber of high quality we have to depend altogether too largely on the remaining virgin stands on the Pacific coast. This involves long and costly hauls to industrial centers at a time when transportation facilities are already severely taxed. And many of these consuming centers have large areas of forest land nearby, potentially capable of good timber production but now producing only a small fraction of what they could.

Throughout the Northeast there are serious deficiencies in material of commercial quality. The depletion of timber resources continues to cause abandonment of local forest industries which have constituted a vital part of the economic life of many communities. Without prompt action to conserve immature growing stock it will be impossible to sustain for many years the present rate of cutting of white pine in New England. It may already be too late to do so. Similarly, continued production of both piling and sawlogs from the loblolly pine forests of the eastern shore of Maryland is being rapidly undermined by the prevalent practice of clear-cutting very young timber.

Liquidation of the small remaining supply of old-growth hardwood timber in the Lake States has been accelerated, and there is a noteworthy increase in the cut of coniferous second growth, especially in 30- to 40-year-old stands in Minnesota. Devastation of these young stands will leave an inadequate basis for future timber crops in many areas where local industries are largely dependent upon the forest. Further heavy inroads are being made on the already depleted stands of hardwoods in Ohio, Indiana, Illinois, and Missouri.

The prolific and fortuitous second growth in the Southeastern States is not standing up under the widespread clear-cutting resulting from the tremendous pressure for increased production. Farm woodland are suffering particularly. Where local people depend upon forest work for their principal cash income, serious hardship impends for thousands after the war.

Lumber production in the Pacific Northwest is again reaching the peak of predepression years. Excessively concentrated and unnecessarily destructive cutting and related practices are jeopardizing opportunities for sustained-yield operations as well as the future productivity of the forest. Only a handful of timber-land owners have plans for the use of their land beyond the present cutting operations. Many communities are bound to suffer.

With all this, an increasing number of progressive operators in all sections are applying conservation practices. Some have organized their holdings for sustained yield under technical supervision. Sponsorship by the National Lumber Manufacturers' Association of land held and managed for future timber growth as "tree farms" and the conservation program of the Southern Pulpwood Producers' Association

ion are encouraging developments. But such efforts are still very much in the minority. About 80 percent of all cutting on private forest lands of the United States is still without conscious regard to perpetuation of timber growth.

FOREST SERVICE CONCERNED, INDUSTRY COMPLACENT, AND PEOPLE CONFUSED

The Forest Service is deeply concerned over the unnecessary destructiveness of cutting and related practices which threatens the ability of the forests to continue to supply adequate raw material for forest-products industries in many communities. It fully recognizes that war demands for forest products must be met. It is aiding such production in every way possible. Simultaneously, it is striving for the elimination of wasteful and destructive practices in order to leave forest lands in productive condition for the future.

The United States, and the world, will need wood for the post-war reconstruction. Wood will be needed for our long-term development and progress as a democratic nation. Abundant natural resources are essential to the realization of our ideal of peace and liberty; they can be developed and maintained only through far-sighted conservation. We do not want to find, after the war is over, that we ourselves have unnecessarily impaired or destroyed one of the basic resources of the land we have been fighting to protect. We cannot afford to temporize when adverse results will be so far reaching and so long sustained as those from needless destruction of productive forests.

In contrast, some forest industries are promoting the idea that the supply of wood is abundant; that lumber, for example, can be readily produced to meet whatever demands the war may impose; and that there is no cause for concern as to the future. That lumber production in 1941 was only 2 percent of the total saw-timber stand is cited, but the equally important facts that lumber constitutes only about 10 percent of total saw-timber drain and that this is nearly double the volume of annual growth are overlooked. By generalizing for the country as a whole, the backlog of virgin timber in the Pacific Northwest masks the extent of depletion of merchantable growing stock throughout the East, particularly that of high quality. Furthermore, far from all of the timber in the Northwest is available.

An apparent approach toward balance of current growth and forest drain prior to the war has been interpreted as a measure of encouraging progress. It is true that improvement in fire protection favorably affects growth and that cutting in the Douglas-fir and some other western types works in the same direction by transferring virgin areas to vigorous second growth. But a more important aspect of growth is the fact that the output of commercial products that can be sustained in second-growth forests, which constitute four-fifths of the total, is as much dependent upon the volume of merchantable growing stock as upon the area devoted to forest growth. Throughout the East growing stocks are already far below the levels needed to maintain the current rate of cutting and, so long as drain continues to exceed growth, cumulative depletion is steadily reducing the amount of usable growth.

Furthermore in the decade preceding the outbreak of war in Europe the use of wood, and hence forest drain, was adversely affected by abnormal economic conditions and the inroads of substitute materials. We do not wish to measure progress in terms of the idle mill capacity and unemployment of that period. It is inconceivable that we should plan an economy which would not provide for utilization of the productive capacity of the one-third of our area which is classified as forest land. Unless aggressive action is taken to stop destructive cutting and conserve essential growing stocks, exhaustion of available timber will eventually lead to a reduction of output which will force a balance between growth and drain at a level far below the potential contribution of the forests to the economic life of the country. Ability to sustain output of commercial products at a high level is thus the only valid criterion of progress.

The conflicting points of view highlighted in the preceding paragraphs leaves the public confused. Unfortunately, people in all walks of life are largely unaware of the critical situation which exists and of the extent to which an inadequate forest policy is holding back and will hold back after the war, efforts to attain for all the people the full potential contribution of the forests to freedom from want and freedom from fear.

Many people are conscious of the great step forward which was made when the national forests were created out of the public domain of the West; of how these forests have been consolidated, expanded and developed; and of how, on an all too limited scale, purchase of critical forest lands in the East has been inaugurated. But few appreciate that public ownership and management extend to only about one-fourth of the forest land of the United States and that while embracing a large part of the lands chiefly valuable for watershed protection and recreational or aesthetic purposes, public forests affect the Nation's timber supply in only a very limited way.

Reports on the millions of trees planted in recent years may have led many people to believe that the Nation's forestry problem was being adequately met in this manner. Activity in the reforestation of idle land has perhaps captured the public imagination and tended to minimize the importance of good cutting and related practices in the remaining virgin forests and of proper management of the second-growth forests wherever they have come up naturally.

Again, the average citizen is probably cognizant of the fact that with Federal aid, the States in the forested regions have rapidly expanded and improved the protection afforded private forest land against fire. But few stop to think that protection against destructive cutting may be as important for the future as protection against destruction by fire.

Since the crux of the Nation's forestry problem lies in the privately owned forest land from which about 95 percent of the Nation's forest products are being obtained, the public should realize that the Government has no authority to control or prevent indiscriminate and destructive cutting on such lands.

PUBLIC REGULATION OF CUTTING PRACTICES NEEDED

The Forest Service believes that now more than ever before, public regulation of cutting and other closely related forest practices is

needed to keep private forest lands reasonably productive on a national scale.

Conservation of a basic growing stock need not and should not preclude reaching necessary wartime production goals. Partial cuttings, in fact, in some cases may yield a given volume of lumber with as much as 10 percent less labor than clear-cutting. Similarly, a given quantity of yellow birch aircraft veneer may be obtained in selective cutting from a log volume one-third less than would have to be handled in clear-cutting.

No country in the world has yet been able to get widespread forestry on private lands without public regulation. There is no reason to believe that the United States will prove an exception.

Public regulation should be adapted to local needs. It must be safeguarded both against bureaucratic administration and against seizure of the regulatory machinery by the interests controlled. Such regulation would minimize the impact of the war on the productivity of the forests. It would protect the progressive owners who practice sound forestry from the unfair competition of the liquidators. It would protect farmers and other small owners who are now largely at the mercy of timber buyers and operators. It would provide the "rules of the game" essential to continued free enterprise and leave ample opportunity for independence, ingenuity, and resourcefulness in business management.

Important though it is, the authority for public regulation covers only one phase of what is needed. Regulation is no panacea. The public should acquire all forest lands that the private owner cannot reasonably be expected to handle properly, and all the forest lands in which vital public interest, such as watershed protection, cannot be safeguarded in any other way. This should be an important part of our post-war reconstruction program.

Furthermore, when the public requires private owners to use reasonably good forest practices, it is only plain justice that it should help them to do so, and encourage them to go beyond minimum requirements to more intensive sustained-yield management. To this end the scope of public aid and cooperation with private owners should be broadened in such forms as protection against fire, insects, and disease; adjustment of taxation where income is deferred; education that gets down to cases in both the management of the forest and the marketing and use of its products; research to improve the basis for forest practices and utilization; credit adapted to the requirements of forestry and conditioned upon good management; and special assistance to farmers and other small owners.

HUMAN WELFARE, THE ULTIMATE OBJECTIVE

Such a far-reaching program must have its justification in the welfare of the people. Concern as to the supply of wood for national defense and civilian use derives its significance from the fact that wood is indispensable in the life of the Nation. Positive action to maintain productivity of our forests will go far toward providing security for rural people throughout our forest regions. The blight of extensive tax delinquency and the scourge of rural slums so characteristic of depleted forest regions must not be allowed to continue or to spread.

Traditionally, hunting, fishing, camping, and other forms of outdoor recreation have played an important part in the American way of life. And an abundance of pure water has contributed to American living standards in most of the forest regions. Conservation of these values is inherent in such a comprehensive forestry program.

Much of the agriculture of the West depends on irrigation water from forested mountains. Beyond that, human misery and proper damage resulting from floods may be mitigated by good management of the forests on the headwaters of our streams.

Finally, technological developments of the power age, opening vistas of a new economy of abundance, rest in no small degree on water-power installations, involving investments of vast sums of money. The longevity and efficiency of such water-power installations are also influenced by the treatment of forests upon the watersheds.

Thus human welfare and the American way of life are so inextricably bound up with the forests which clothe our mountain watershed, afford us sanctuary for rest and recreation, and supply raw materials for fuel, shelter, and industrial activity, that further needless forest destruction and mistreatment must be stopped. Because of the acceleration of forest depletion resulting from the war, public action must be prompt and Nation-wide. The job cannot be done without large Federal participation and strong Federal leadership as a minimum.

WAR ACTIVITIES OF THE FOREST SERVICE

RECOGNIZING the strategic and vital importance of wood in a war economy and the challenge which war production would mean to conservation, the Forest Service mobilized its personnel and facilities for maximum contribution to the war effort immediately after the Japanese attack on Pearl Harbor. Actually this meant an intensification of work already started under the pre-war defense program; in many cases it required the shifting of employees from less pressing work to activities contributing directly to the war effort. Normal activities have been pruned to the minimum consistent with discharge of the responsibility of the Forest Service to protect and maintain the national forests and to provide essential research and educational guidance for better management of privately owned forests.

Because of its far-flung field organization, with men familiar with local conditions and competent to deal with various technical problems, the Forest Service has been able to function rapidly and efficiently in meeting wartime needs. And our men have displayed vision and forethought extending beyond the range of their individual spheres of work.

USDA WAR BOARDS AND 1943 PRODUCTION GOALS

Throughout the forest regions, Forest Service men have taken an active part in the work of the State and county War Boards organized by the Secretary of Agriculture. In some States standard contract forms to facilitate sale of farm timber were prepared. In addition to taking leadership, with respect to forest-products and range-livestock problems, Forest Service men participated in other phases of

the Food-for-Freedom campaign, and Forest Service "show-boat" equipment was used to carry War Board information to the people.

Drawing upon sources of information not available to the War Boards, the Forest Service in Washington compiled comprehensive data on 1942 production of forest products and prospective requirements for 1943. It was shown that unless aggressive steps are taken, 1943 production of lumber, pulpwood, and fuel wood are all likely to fall substantially below 1941 and 1942 figures. Government action appears necessary to stimulate logging and sustain operations, particularly of small mills most affected by the disruption of normal markets. The farm labor shortage presents a major problem in holding fuel-wood production up to even normal levels.

REQUIREMENTS, SUPPLIES, AND PRODUCTION OF FOREST PRODUCTS FOR WAR USE

To aid in the production of wood products for war, the Forest Service, working under agreement with the War Production Board, the Office of Price Administration, and other agencies, collected information, made surveys, and otherwise performed services dealing with requirements, supplies, and production of forest products for the war program.

Pulp mills were canvassed to obtain data on production, consumption, and origin of pulpwood, its transportation, and related factors. A survey of manufacturing facilities and available supplies of white oak for shipbuilding was made in the Appalachian area. The requirements and supplies of veneer and plywood for airplane construction and other war uses were surveyed and a check was made on the diversion of veneer logs to other uses.

Looking to the possibility of increasing supplies of tannin, the availability of chestnut wood and the capacity of extraction plants were investigated. Possible tannin production from mangrove bark in Florida and "canaigre" in the Southwest were explored. The accumulation of western hemlock bark for tannin was also considered.

In an effort to develop substitutes for cork formerly imported from Mediterranean countries, the Forest Products Laboratory worked out a method of separating corky tissue from the bark of Douglas fir. Yields of pure granular cork ran as high as 43 percent from bark of Rocky Mountain origin.

Determinations of military and civilian needs for hardwood and softwood lumber are being made periodically and statistics on production and stocks of forest products are being collected currently. Forest Service representatives were assigned to the War Production Board, Army Ordnance, and other agencies to help solve their wood-utilization problems, including the preparation of well-balanced specifications for various items. At the request of the Treasury Department, the Forest Service is handling all inspection of logs procured for lend-lease shipments.

Special attention has been given to the study of factors holding back production in 1942. Labor, transportation, machinery, tires, and weather were considered. The effect of ceiling prices on certain species of logs in the Pacific Northwest was studied.

In view of the critical shortage of rubber, the Forest Service investigated the dependence of the forest industries on motor transportation. One-third of the lumber, four-fifths of the logs and pulpwood, and practically all of the naval stores produced in the United States are moved on rubber. Transportation authorities were advised that a 2 percent reduction in the use of rubber by the forest industries could be effected by economy and close integration in the use of all transportation facilities.

As a result of salvage work undertaken by the Forest Service following the New England hurricane of 1938, some 687,000,000 board feet of timber, much of which might otherwise have burned, rotted, or been destroyed by insects, is being made available when war-industry demands are heavy. The salvage program benefited nearly 13,000 farmers and other woodland owners.

With definite shortages of coal and fuel oil for domestic use fore-shadowed in some areas, fuel users are being urged to substitute wood for coal and oil wherever feasible. The Forest Service encouraged more widespread cutting of fuel on the national forests, from which tens of thousands of rural people obtain wood annually. It also cooperated with the Extension Service and State forestry agencies in campaigns to stimulate the cutting of cordwood on private lands and to direct such cutting along lines of good forestry.

With 1942 requirements of naval stores estimated at 58 percent above 1941 production, the Naval Stores Conservation Program administered by the Forest Service in cooperation with the Agricultural Adjustment Agency assumed new significance. Special effort was made to increase production through efficient operating methods and improved fire protection. In some cases the Forest Service acted as liaison agent, enabling small farmers to obtain Farm Security Administration loans so that they could bring into naval stores production stands of timber that had not previously been worked.

One promising development grew out of the experiments of the Southern Forest Experiment Station with acid stimulation of gum yield. It was found that a solution of sulphuric acid applied to freshly-chipped slash pine "faces" increased the yield of gum as much as 60 percent. Large-scale testing and demonstration of the use of the technique were organized. Research was greatly intensified in the hope of finding a treatment effective for longleaf as well as slash pine.

AIRCRAFT SPRUCE FROM ALASKA

The war has created a critical need for Sitka spruce for the construction of airplanes. Available supplies of spruce of airplane quality in the Pacific Northwest are insufficient to maintain the production needed.

The Forest Service, at the request of the War Production Board, surveyed the possibilities of drawing on the spruce stands of the Tongass National Forest of southeastern Alaska, and on June 5 the Secretary of Agriculture approved an agreement between the Commodity Credit Corporation and the Forest Service under which the Service, financed by the Corporation, is undertaking a large-scale enterprise for the extraction of Alaskan timber. A goal of 100 million board feet of high-grade spruce logs per year has been set for the duration. The

logging is to be done by independent contractors and the logs will be rafted some 900 miles for manufacture by mills in the United States.

NEW SOURCES OF RUBBER

For many years natural rubber has been produced commercially but in limited volume from guayule, a desert plant native to parts of northern Mexico and to the Big Bend area of Texas. In the United States, production was limited to one concern with several hundred acres of plantations and a small extraction plant in the Salinas Valley of California.

When Japanese conquest and shipping difficulties shut off the supply of imported rubber, guayule was looked to as one of the most promising domestic sources of natural rubber. An act of March 5, 1942, authorized the Department to acquire the properties and processes of the Intercontinental Rubber Co. and expand production of guayule and other rubber-bearing plants in the Western Hemisphere. Production phases of the emergency rubber project inaugurated under this act were assigned to the Forest Service, and essential technical investigations to the Bureau of Plant Industry and the Bureau of Agricultural Chemistry and Engineering.

The first urgent task was to increase nursery production of guayule seedlings. It was a race against time, as the seed had to be in the ground before the start of the dry season. In a little more than 2 months, 530 acres of nursery beds were soil-tested and prepared, and the treating and sowing of 21,000 pounds of cleaned seed was completed. The job required, in addition to the leasing of nursery sites, the installation of an overhead irrigation system with 94 miles of pipe, the laying of 1,014 miles of duckboard tracks for machinery between nursery beds, and the construction of a seed-treating plant and housing for 1,000 workers.

In addition to the nursery sowing, 870 acres of field planting was completed in April, with seedlings acquired from the company. The seed acquired from the Intercontinental Rubber Co. will provide enough seedling plants for about 32,000 acres of field plantations in the winter of 1942-3. Nearly 100 indicator plots were set out by the Bureau of Plant Industry in Southwestern States and in Mexico to determine areas suitable for guayule cultivation. Land in suitable areas will be leased for this winter's field planting.

Some rubber can be obtained from guayule within a year after field planting but the yield increases annually for a number of years. The most economical harvest usually can be made 4 years after field planting, when a yield of from 1,200 to 1,500 pounds of rubber per acre has been obtained. However, in order to get early production, field operations are being planned on a 2-year rotation.

In the hope of developing other more immediate sources of natural rubber, the Forest Service investigated the supply of native guayule in southwestern Texas, but found very little. About 540 pounds of Russian dandelion (*Taraxacum kok-saghyz*) seed obtained from Russia by the Bureau of Plant Industry were planted at agricultural experiment stations in 20 Northern States for adaptability tests and by the Forest Service in its nurseries for seed production. This plant may be harvested at the end of the first growing season. It is understood to be cultivated annually on about 2 million acres in Russia.

NEW AND IMPROVED USES OF WOOD FOR WAR

Work of the Forest Products Laboratory is now focused almost entirely on war problems—finding wood substitutes for scarce materials, adapting natural or processed wood to military uses, and directly promoting efficient wood use. Most of this work was initiated as part of the defense program prior to the attack at Pearl Harbor.

In August 1941 the Laboratory sought the advice of aircraft manufacturers and the National Advisory Committee for Aeronautics on its aircraft research program. Since then the Army, Navy, and the aircraft industry have been furnished extensive data on the design and fabrication of wooden airplane parts, and on the cutting, selection, seasoning, and gluing of plywood and lumber. The Aeronautical Board was also assisted in preparing aircraft specifications covering such items as structural lumber, propeller lumber, plywood, kiln drying, and cold-setting resin glues.

The Laboratory assisted in the preparation of a handbook on Design of Wood Aircraft Structures and at the request of the Aeronautical Board it prepared a Wood Aircraft Fabrication Manual.

A means of fabricating laminated keels, frames, and other structural members for small naval craft was developed. The process permits the use of lumber for these members instead of large timbers which are becoming increasingly difficult to obtain. "Compreg," a new material formed by the compression and impregnation of wood with phenolic resins with strength properties comparable to mild steel, has been adapted for use in aircraft spar plates, propellers, and landing wheels.

Research on boxing and crating was greatly expanded by allotment of funds from the War Department. The Army Ordnance Department commissioned the laboratory's container staff to revise and redesign its boxes and crates and to serve as consultants to aid in packaging and shipping the Nation's fighting weapons and materials. Problems involving tanks, field artillery, machine guns, fire-control directors, scout cars, motors, etc., have already been solved. Training courses for Ordnance Department packaging inspectors are being given at frequent intervals.

Lightweight and compact container designs were prepared for transport of equipment and materials by air. In cooperation with the Office of Agricultural War Relations, detailed estimates were made of packaging requirements for agricultural commodities. Specifications prepared by the Laboratory for the packaging of cheese, eggs, condensed milk, and other foods for lend-lease shipment gave added strength to the containers and reduced costs while saving cargo space, lumber, and other materials.

A new type of interior paint was developed which retards the spread of fire in wood construction. A new substance obtained from wood lignin was found to improve the antiknock characteristics of gasoline to a greater extent than some of the materials now in use. The adaptation of the laboratory's wood plastic for storage-battery cases and tops in place of hard rubber was worked out in cooperation with a large manufacturer.

Studies of automobile house trailers, in demand where new industries have been established, showed that 90 percent of the metal used in them could be replaced by wood. A preliminary analysis was

made to determine the possibility of employing wood or resin-impregnated paper in the construction of oil pipe lines in place of metal. A possible substitute for imported hemp and sisal was sought by investigation of the yucca group of desert plants in the Southwest.

EMERGENCY FOREST-FIRE CONTROL

It is imperative that the number and size of forest fires be held to a minimum during wartime to avoid disorganization of transportation and communication, to prevent diversion of industrial labor or military forces to the unproductive task of fire fighting, and to avert direct damage to forest resources and industries and facilities located in forest areas. The Secretary of War and the Western Defense Command have pointed out the importance of adequate fire control from a military standpoint.

With the menace of sabotage and of possible incendiary bombing by the enemy added to normal hazards, the Nation faces greater danger from forest fire than ever before. Yet the call of men to arms and to war industries and reduction of the Civilian Conservation Corps has depleted the regular fire-control forces of the Forest Service and the State forest-protection agencies. In order to intensify forest-fire protection in the most critical areas, Congress made emergency appropriations twice during the year. More than two-thirds of the \$6,100,000 available was allocated to the Northwestern States where danger is greatest and where incendiary fires could be most disastrous.

In this situation the work of the experiment stations in developing for each forest region fire-danger meters which show at a glance the combined effect of weather and other factors influencing fire danger, is proving its worth. These meters, translating the results of past work in measuring and interpreting fire behavior into fire-control planning and action, enable the protection agencies to work with greater assurance and effectiveness.

To supplement the public effort, the Office of Civilian Defense cooperated in establishing a Nation-wide Forest Fire Fighters Service. The response in all regions was extremely gratifying. Many farmers and ranchers, citizens of urban communities, and civilian groups, such as mountaineering clubs, labor unions, and veterans' organizations, volunteered for training and service on call. Through a cooperative agreement, the Office of Civilian Defense also made available for forest-protection service the personnel and aircraft of the Civilian Air Patrol.

With the cooperation of the National Advertising Council, State presters, civic and conservation associations, women's and young folks' organizations, and many other patriotic groups and individuals, the Forest Service intensified its publicity campaign for the prevention of forest fires.

SERVICES TO THE MILITARY

About 500,000 acres of national-forest land in seven States, Alaska, and Puerto Rico have been transferred to the War and Navy Departments or made available through cooperative agreements for military reservations, artillery ranges, maneuver areas, proving grounds, etc. Forest Service equipment and repair shops in several areas are aiding military operations.

The Federal and State networks of forest lookout stations now constitute part of the Army's far-flung aircraft warning system for the protection of our coastal areas. Prior to the Pearl Harbor attack the Forest Service had cooperated with the Air Defense Command in aircraft detection tests and in the development of over-all plans. By June 30 more than 450 lookout stations were manned 24 hours a day by trained observers. Forest Service communication facilities will be instantly integrated with military systems in the event an national-forest territory becomes an actual theater of war.

Forest Service experience in dropping supplies and personnel for fire fighting by parachute was of value to the Army in the organization of American parachute troops. Portable, 2-way radiophone equipment developed by the Forest Service has also been made available to the Army.

The engineering facilities of the Forest Service were called upon by the Army Corps of Engineers for aerial photography, photogrammetry, and topographic-mapping work covering more than 4,000 square miles in California.

Under the Facility Security Program the Forest Service was charged with responsibility for the protection of timber and related forest-products facilities from damage or production interruptions due to sabotage or wartime fire hazards.

Forest Service men were assigned to many other projects of direct service to war operations—to aid in the selection and acquisition of sites for war industries, military camps, bases, and various operations; to assist in camouflage plantings and in the revegetation of air fields; for consultation in organizing and training mountaineering troops; etc.

REGULAR WORK TAKES SECONDARY POSITION

RESEARCH REORIENTED FOR WAR NEEDS

IN ORDER that the maximum effort be available for war work within the sphere of authorized forestry activities, the entire program of Forest Service research was reviewed and revised. First priority is now being given to projects which are directly concerned with the war effort. Projects contributing technical background for post-war reconstruction and reemployment are being maintained in secondary position. A few projects involving cooperative commitments are also being continued. All other projects are being postponed except for the minimum of maintenance necessary to prevent deterioration of permanent installations, or loss of past investment in long-time investigations.

Along with this over-all reorientation, the drastic curtailment of appropriations for the fiscal year 1943 made it necessary to abandon the Northeastern Forest Experiment Station, which has served New England and New York, and to close out or drastically curtail entire lines of work at some other stations as well.

Forest-Products Research Ready for War Service.—Thirty-two years of objective research aimed at increasing the efficiency of wood in service and finding new uses for wood, have enabled the Forest Products Laboratory to be of immediate service in supplying much

technical information needed by war agencies and in bringing about the substitution of wood for metals and other strategic war materials. As highlighted in a previous section (p. 12), the program and personnel of the Laboratory is now on a war basis.

Forest Economics Information Finds War Use.—War-production agencies have drawn heavily upon Forest Service compilations of tumpage, log, and lumber prices and of production and distribution of lumber and other forest products. To meet more exacting war needs the lumber-production estimates were improved for 1941 by complete field canvass in 10 additional Eastern States. Preliminary figures were made available 3 months earlier than usual.

Regular work on several forest economics projects was suspended or reduced in order to release men for special studies relating to supplies and requirements of forest products in the war. Results of studies of financial aspects of partial cutting in southern pine were prepared for publication, and studies of problems arising from tax delinquency in the Pacific Northwest also were completed. Previous work on the forest insurance problem facilitated the extension of war-damage coverage to forest crops.

The forest cooperative at Cooperstown, N. Y., which has been sponsored by the Forest Service and which has served as an experimental enterprise for study of cooperative organization for farm-forest management and utilization, has not only become a significant factor in the production of materials for war industries and for the construction of war facilities, but also has gained recognition and acceptance as a valuable addition to the economic life of the rural people it serves.

Forest Survey Data in Great Demand.—The forest survey, which has now covered some 300 million acres of timberland, is currently being called upon by war agencies for data on timber volume, quality, and availability. It has been necessary to make special compilations and cruises in 20 States to determine the quality and volume of species suitable for aircraft, shipbuilding, and gunstocks. Industries have been canvassed to determine the volume of such species being utilized. Forest-type maps have been supplied the Army for certain coastal areas.

Forest-Management Research Points Way to More Effective Production.—In reorienting to war needs, primary emphasis in forest-management research is being given to work relating to forest-fire control, and to stimulation of naval stores production as mentioned in a previous section. Research experts in forest seed, nursery, and planting practices are also being called upon to assist war agencies in the selection and planting of quick-growing plants for camouflage, and in planting to stabilize the soil and prevent the shifting of sand dunes in strategic areas. Research on tree nutrition and reaction to growth substances is proving of value in increasing survival and growth rate in such plantings regardless of seasons.

With the Nation becoming increasingly dependent for its saw timber on what is being grown under management, the work of the experiment stations on methods of partial cutting assumes new significance. Numerous experimental cuttings show that future productivity may be increased and stabilized by partial cutting and that output per man in current operations may be increased.

In the hemlock types of Pennsylvania, light cuttings in the past have been followed by average annual growth of 440 to 480 board feet per acre, whereas, when all merchantable timber was removed growth was only 131 to 200 board feet per acre. The lighter cuttings reduced the value of the harvest very little because much of the residual stand was in trees too small to make good sawlogs, yet it was these trees which provided the base for the increased growth. Similar results were reported during the year for northern hardwoods, ponderosa pine, and black spruce.

The investment of the stations in thinning experiments is also beginning to pay dividends. In the Lake States, where pulpwood is much in demand, commercial thinnings in 30- to 35-year-old pine and aspen stands are yielding 4 to 5 cords per acre.

Research is thus providing assurance that products needed for the war can be obtained under forest management with an increased efficiency in the use of available manpower and without detriment to future productivity of the land.

More effective provision for the future is also being built up in experiments in the Central States and the Northern Rocky Mountains which are demonstrating techniques for direct seeding to speed up and reduce the cost of the reforestation of burned areas and old fields. To the same end during the current year a manual of nursery practice for the production of broad-leaved stock for planting in the Prairie Plains region was issued.

Forest-Influence Research Aids in Solving Water-Supply and Flood-Control Problems.—Although watershed investigations for flood control have been largely discontinued, an emergency survey on the San Diego watershed is being initiated to design an upstream control program to protect Army camps, supply depots, and war industries. Programs recommended for other watersheds constitute a backlog for post-war employment. Based on accumulated knowledge of the role of vegetative cover, technical service is constantly being provided the War Department and State highway departments on methods and plants to use in stabilizing road banks and protecting them from destructive washing.

The manner in which forest management may influence stream flow has been greatly clarified by studies on the Connecticut River watershed. The depth and character of humus soil in the forest varies widely with age and character of the tree growth. The depth of the humus layers in turn determine their capacity for detaining water being fed into the streams. Hydrological calculations indicate that on certain tributaries of the Connecticut River, improvement of forest cover through management holds promise of reducing flood flows by the equivalent of 2 or 3 inches of rainfall.

Efficient use of hydroelectric installations is being fostered by prediction of stream flow by the Appalachian Station based on studies of ground-water levels and run-off from small watersheds.

By interception of precipitation, dense stands of conifers may cause 30 percent or more of the snowfall to be evaporated. The Rocky Mountain Station has shown that thinning and other special cutting practices may increase the water available in snow cover for irrigation purposes by 2 or 3 inches.

Range Research Improving the Production of Meat, Hides, and Wool.—Sustained high production of meat, hides, and wool during

the present conflict is vital. The country's 950 million acres of range lands, largely in the West and South, are playing an important part in such production. With an increase in the numbers of cattle and sheep during the last few years, western ranges are already stocked to capacity and many areas are crowded. Unrestricted expansion during the First World War, in an effort to increase production, failed to give the expected increase in meat and wool. It caused serious range depletion, erosion, financial loss, and social misfortune.

Sustained production during this war must be achieved without a repetition of the mistakes of World War I. Effective balance between range forage, supplemental feed, and numbers of animals, must be maintained. To this end the Forest Service has participated both in the formulation of desirable production and marketing goals for livestock and in State War Board action to attain such goals. Simple, practical guides for efficient forage utilization and range conservation have been issued. The Forest Service has cooperated with the Agricultural Adjustment Agency in the training of its range examiners concerned with the management of private range lands throughout the West.

The widespread range research of the Forest Service in cooperation with other agencies of the Department and years of experience in the administration of range lands, point the way for wartime increases in production of meat, hides, and wool without detriment to the range-land resource. In northern Great Plains experiments, improved range management has increased the calf crop 12 percent and given a 35-pound increase in the weight of calves per cow. Experiments in the Southwest have resulted in doubling the grazing capacity, increasing net calf production 50 percent, and cutting death losses 65 to 80 percent on ranges under management as compared to unmanaged ranges. Improved wintering practices on Utah sheep ranges increased the yield of wool by 1 pound per animal and resulted in a 5-percent greater lamb crop. Cooperative studies in the Sierra foothills of California show that conservative grazing increased early forage production and that supplemental protein feeding increased the calf crop as much as 31 percent and the marketing value of yearlings from \$3 to \$6.50 per head. Publication by the North Carolina Agricultural Experiment Station of results of a cooperative study points the way to improved management in the rapidly expanding production of beef cattle on forest land in the Southeast.

Also contributing to optimum conditions for livestock production are findings that the important blue grama grass ranges of the Southwest can be restored and maintained by stocking which does not result in utilization of more than 40 percent of the current forage yield and that prickly pear, a prostrate cactus which has become a great pest of the Great Plains ranges, can be economically controlled.

To help meet heavy wartime demands for forage, specific guides based on experimental work have been issued for reseeding some 4 million acres of depleted range lands and abandoned fields in the northern Plains and northern Rocky Mountain regions.

Concluded with significant results were fundamental physiological studies of range grasses and herbaceous plants of central Utah upon which practical recommendations concerning the season, degree, and system of grazing on western mountain ranges can be made. The Forest Service participated in the preparation of a volume on "Standard-

ized Plant Names". This publication represents a long step toward order in the use of plant names.

ADMINISTRATION OF NATIONAL FORESTS HANDICAPPED BY LOSS OF MANPOWER

Maintenance of normal standards in the protection and administration of the 177½ million acres of national forests became increasingly difficult as experienced personnel, both permanent and temporary, were lost to the military and war-industrial establishments. Reductions in the number of C. C. C. camps, which were entirely eliminated June 30, also affected adversely the manpower available for forest development and fire fighting.

Offsetting this in a small way, 10 Civilian Public Service camps were assigned to the Forest Service to provide work of national importance for conscientious objectors. Seven additional C. P. S. camps were operated in cooperation with State forestry agencies on State and private forest land.

1941 Fire Season Near Normal.—Fortunately the fire situation in the year 1941 was generally more favorable than in previous years and fire-control results showed a gratifying improvement over the previous 5-year average. A normal season in the West was broken during July when a series of lightning storms left 1,015 fires on the national forests of the North Pacific region. This serious situation was controlled effectively and promptly. The Southern region experienced a high fire-danger season from February to May in which 1,586 fires, 98 percent man-caused, burned 97,000 acres within national-forest boundaries.

A study on the financial intensity of fire control which will best serve the public interest has led to a statement of regional needs for adequate fire protection. Increased emphasis has been given to the training of fire personnel with specially prepared motion pictures used extensively in the process. Progress continues in the improvement of equipment, notably in the high-frequency, 2-way portable radio sets and in portable chain-saws with lightweight gasoline motors. The technique of parachute jumping for fire fighters in remote regions has been further developed and has now passed beyond the purely experimental state.

Volume of Timber Sales Taxes Technical Staff.—Wartime requirements for timber stimulated national-forest timber sales in every region, and put a severe strain on the technical staff available for handling the business. The volume of timber cut from national forests increased from 1,290,561,000 board feet in the fiscal year 1939 to an all-time high of 2,204,749,000 board feet in the fiscal year 1942.

To meet wartime demands, increases in annual cutting budgets have been authorized on forests where failure to sell the volume set up under the sustained-yield plan in previous years had led to an accumulated reserve. Available chances are being appraised and promptly advertised for sale wherever there is a possibility that local operators can be interested. Silvicultural standards are being maintained in all cases. The heavy demand made it possible to open up some areas not previously considered accessible. There was a marked increase in the sale of species and material not normally in demand.

In order to facilitate sales and reduce the cost of administration, short-cut procedures are constantly being explored. The sale of marked timber with volume determined by tree measurement so as to eliminate log scaling was expanded. In the Lake States a reliable method that was developed for measuring whole loads of aspen box bolts in terms of cords saves from 50 to 90 percent of the expense of piece scaling.

Forest Planting and Plantation Care.—Because of the war, steps have been taken to curtail drastically the forest-planting program. Stock available this season was set out but nursery work was reduced to little more than a maintenance basis.

In order to avoid heavy losses in earlier plantings where trees were being crowded out by brush and worthless species, release cutting is necessary. Because C. C. C. and W. P. A. labor for this purpose was no longer available, Congress appropriated \$500,000 to carry on until June 30, 1943. About 255,000 out of the 1,126,118 acres of established plantations were in need of such treatment.

National Forest Range Conservation Maintained.—Range lands within the western national forests, normally furnishing seasonal grazing for more than 10 million head of cattle and sheep, will play a key part in providing the meat, wool, and hides needed by the Nation and its allies in the present world conflict. Having been under protection and management for 37 years, national-forest ranges are on the whole in better position to produce a sustained yield of palatable forage than other ranges of comparable size and character. The contribution of national-forest ranges to the economic support of many communities as well as to the 40,000 people who obtained permits for range use in 1941, is as significant as is their contribution of products to the Nation's wartime production program.

Flood-Control Improvement on Critical Watersheds.—Wartime restrictions forced curtailment of flood-control programs. However, the critical Arroyo Seco project on the Angeles National Forest was continued. An intensive system of fire-control improvements is nearing completion. Vegetation established by planting is minimizing soil erosion from road fills and other barren areas. Permanent channel barriers are being constructed to stabilize the large volumes of flood debris that otherwise would eventually be moved into Devils Gate Reservoir which protects an important part of the metropolitan area from flood damage.

Welfare of People Promoted by Forest Recreation, Community Aids, and Wildlife Management.—It is probable that curtailment of travel this year will cause a drop in the recent impressive increase in public utilization of national-forest recreational facilities. Recreational areas were used by about 18 million persons in 1941, an increase of almost 2 million over 1940. Camp and picnic areas account for half of the visits recorded in 1941 while visits to winter-sports areas reached 1½ million.

In addition to catering to the needs of visitors, the eastern national forests are being developed in a more direct way to serve the million people in low-income families living within the forest boundaries. Of these some 2,500 families are actually tenants on national-forest land.

Long-term demonstrations of rehabilitation-in-place for such forest communities were started several years ago with the aid of the Farm

Security Administration. In the Drummond Community in Wisconsin 31 families have settled. The Selimity Community in Kentucky has 51 families. Agronomists and welfare workers help these families increase crop production and better their standard of living. Work opportunities are provided on the national forests.

Concentrations of population adjacent to military establishments, and new war industrial plants present problems in recreation and housing. The Forest Service is doing all it can within limitations of its funds to meet such needs. New sites with sanitary and other facilities have been developed for temporary trailer housing of war workers. National-forest "organization camps" and other facilities have been made available to the Army for use as rest camps or recreation areas.

With the Nation's manpower fully utilized and travel restricted, there will be less hunting and fishing in the more remote parts of the national forests. This will benefit wildlife where populations are sparse but elsewhere may permit wildlife populations to get out of bounds and aggravate already overstocked conditions.

In readily accessible areas adjacent to cities, war industries, and military centers, the demand for hunting and fishing will continue to exceed the supply of game and fish. Special effort is being made to stock streams in such areas more heavily and to provide as much game as is consistent with local environmental conditions.

The long-range significance of the wildlife resources may be envisaged by realizing that aside from recreational values, the annual increase of the big-game herds on the national forests, now estimated at 2 million head, would provide a liberal meat diet for 225,000 people.

Regular Acquisition and Engineering Activities Curtailed.—With only \$1,797,348 available for the year under the Weeks law, supplemented by \$292,869 appropriated for acquisition from national forest receipts, expansion of the area in public forests continued on a restricted basis. The purchase of 243,522 acres was approved at an average cost of \$4.53 per acre.

Construction of roads on national forests for access to strategic metals, such as chrome and tungsten, is being pushed in Idaho, Montana, Oregon, and California. However, progress toward completion of the regularly planned transportation facilities will be retarded by lack of regular funds for other than maintenance. More than half of the planned road development on national forests and one-third of the planned trail mileage are still awaiting construction.

FARMERS AND OTHER PRIVATE OWNERS AIDED IN APPLYING FORESTRY PRACTICE WHILE PRODUCING FOR WAR

Farm Forest Extension.—The tremendous demand for forest products as a result of the war has greatly increased the pressure on farmers to sell their standing timber. Every effort possible is being made by cooperating agencies to prevent unnecessary destruction of woodland resources by advising and assisting farmers in proper management, harvesting, and marketing practices. Adherence to proper cutting practices should have little, if any, effect on volume of production for war. In fact, in the event of a long war, such prac-

ces will sustain and augment the wood supply. In certain critical sections or for certain strategic species this may be a prime consideration.

Forest-Farming Projects.—Two additional forest-farming projects were established in 1942 under the Cooperative Farm Forestry Act—1 in Vermont, the other in Tennessee. This makes a total of 10 such projects under Forest Service directions, 9 of which involve State cooperation and administration.

Cooperation with the Farm Security and Farm Credit Administrations.—In 1941 the Forest Service loaned the services of qualified foresters to the Farm Security Administration to draw up and set out a plan whereby better woodland management might be accomplished on farms serviced by it. As a result the Farm Security Administration made it possible to employ eight competent foresters to train its personnel in forest management and marketing work and to assist Farm Security Administration clients on forest problems. A similar arrangement was effected with the Federal Land Bank of New Orleans.

Aid to Industrial and Other Forest-Land Owners.—Outside of the farm-forestry field the Forest Service aided a large number of small owners with their management and marketing problems. Cooperative organization was encouraged as a means of meeting these problems. Work with larger timberland owners involved economic analyses of operations directed at application of partial cutting and the protection of immature timber.

While it was possible to contact less than 1 percent of the forest land owners needing assistance, the aid given those reached resulted in improved practices in 73 percent of the cases.

Cooperative Production and Distribution of Forest-Planting Stock.—Cooperation with the States and Territories in the production and distribution of forest-tree seedlings for planting on farms was continued to be reacted in a greater forest-planting effort. A total of 97,650,000 trees were sold to farmers at prices somewhat below cost of production. This is an increase of about 10 million over the previous year. Interest in forest planting is growing most rapidly in the South.

Forest Fire Cooperation.—Forty-two States and Hawaii are now engaged in the cooperative protection of State and private forest lands. Utah was added to the list during the year. The total area of land in need of organized protection has been placed at 426 million acres. The area actually protected during the year was approximately 282 million acres. The one-third of the area needing protection is still unprotected. The bulk of the unprotected area lies in the South. During the year, fires in over 16 percent of the unprotected area but only 1.1 percent of the protected area was burned. These figures emphasize the need for extending and strengthening the cooperative fire-control program.

To protect adequately all State and private forest lands under normal conditions will cost approximately \$18,000,000 per year. The total amount spent during the fiscal year 1942 for protecting the lands under the cooperative provisions of the Clarke-McNary law was \$10,307,087, of which 23 percent or \$2,381,258 was Federal and 77 percent or \$7,925,829 was State and private. In other words, funds

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Forest Fire Cooperation.—Forty-two States and Hawaii are now engaged in the cooperative protection of State and private forest lands. Utah was added to the list during the year. The total area of land in need of organized protection has been placed at 426 million acres. The area actually protected during the year was approximately 82 million acres. Thus one-third of the area needing protection is still unprotected. The bulk of the unprotected area lies in the South. During the year, fires ran over 16 percent of the unprotected area, but only 1.1 percent of the protected area was burned. These figures emphasize the need for extending and strengthening the cooperative fire-control program.

To protect adequately all State and private forest lands under normal conditions will cost approximately \$18,000,000 per year. The total amount spent during the fiscal year 1942 for protecting these lands under the cooperative provisions of the Clarke-McNary law was \$10,307,087, of which 23 percent or \$2,381,258 was Federal and 7 percent or \$7,925,829 was State and private. In other words, funds

available from all cooperating agencies were only half enough to do the job. Although war emergency appropriations have offset in part the loss of the Civilian Conservation Corps in the protection effort, State and Federal agencies still are unable to provide the intensity of protection they know is needed.

PRAIRIE STATES FORESTRY PROJECT TRANSFERRED TO SOIL CONSERVATION SERVICE

The Prairie States Forestry Project was transferred to the Soil Conservation Service on June 30, 1942. During the 8 years it was administered by the Forest Service 18,600 miles of remarkably successful field shelterbelts were planted in the States of North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. Much of the success of these plantings is a result of the cooperation received from the farmers, counties, States, and others. In total 30,223 farmers participated in the program. The Nation will be lastingly benefited by the increased yields of food crops which result from the protection afforded by the shelterbelts.

CIVILIAN CONSERVATION CORPS TERMINATED

Throughout the 9 years of its existence the Civilian Conservation Corps was largely concerned with forest conservation. At the beginning its work projects were almost entirely sponsored by the Forest Service. As the program broadened the Forest Service retained responsibility for the work programs of Federal, State, and private forestry camps and for those assigned to the Tennessee Valley Authority. In Alaska and Puerto Rico the Forest Service was responsible for camp administration as well as the work program.

Because State and Federal forestry agencies were ready with a program of work in the protection, development, and improvement of public forests, it was possible to set up 1,131 forestry camps in 1933 before the program was 3 months old. At the peak in 1935 when the corps had 2,652 camps with 520,000 enrollees, there were 1,303 forestry camps. After the total number of camps was reduced to 1,500 on January 1, 1938, the number assigned to forestry averaged 620. By 1941 the war emergency began to affect enrollment; many enrollees and eligibles of draft age went into the armed services and war industry also attracted the young men. Besides, camps were diverted from forestry and other activities to do improvement and development work on new and enlarged military reservations. Only 97 camps were being administered by the Forest Service when the C. C. C. was terminated by Congress, June 30, 1942.

The magnitude of the contribution of the C. C. C. to American forestry is partially expressed in statistics of work done. This has been estimated at 730,000 man years, valued at perhaps \$876,000,000. The details of lookout towers, cabins, storehouses, garages, bridges, and dams built; campgrounds and recreational sites improved; miles of telephone lines, roads, trails, and firebreaks constructed; areas of trees planted and forests thinned and improved; pounds of tree seed collected, cleaned, and planted in nursery beds; man-days spent

in fighting forest fire, combating forest insects, guarding and policing public campgrounds, etc., are impressive and challenging.

Federal forests were increased by 7,725,000 acres through purchases from C. C. C. funds from 1933 to 1937. Under the stimulus of this program the acreage of State forests also increased rapidly all over the United States. These new public forests were promptly developed and improved by C. C. C. manpower.

The C. C. C. became the main line of defense against fire not only on all public forests but also on most of the privately owned forest land and that had been organized for protection under the Clarke-McNary Act.

Less tangible, but perhaps fully as significant was the effectiveness of the C. C. C. in popularizing forestry throughout the Nation. Thousands of the boys who served in the C. C. C. are going forward imbued with a sense of understanding and pride, ready to exert their influence for forest conservation in whatever positions they may find themselves.

FISCAL

During the fiscal year 1942, expenditures by the Forest Service aggregated \$50,899,562. These monies, derived from and accounted for under 62 separate appropriation titles, included:

Cooperation with States and private agencies in fire control, planting and forest practice, \$3,316,539; contributions for fire control, slash disposal, improvement work, etc., \$4,165,615; forestry camps of the Civilian Conservation Corps on State and private lands, on national forests, and on land controlled by certain other Government agencies, \$12,162,282; Emergency Rubber Project, \$2,725,384; research \$2,390,299; expenditures for other Government agencies, \$3,732,881; general administrative expenses, \$600,291.

Expenditures for the national forests aggregated \$21,806,041, of which \$15,489,615 was for operation and protection, \$4,364,417 for forest roads and trails, and \$1,970,009 for acquisition of land.

Net receipts from national forests during the fiscal year totaled \$7,164,890, of which amount \$1,692,877 was returned to the States in accordance with existing law.

A service-wide revision of accounting procedures was made in fiscal year 1942 in order that accounting for Forest Service funds would be better correlated with budgetary and administrative needs.



REPORT OF THE CHIEF OF THE FOREST SERVICE, 1943

U. S. DEPARTMENT OF AGRICULTURE,

Washington, D. C., October 15, 1943.

HON. CLAUDE R. WICKARD,

Secretary of Agriculture

DEAR MR. SECRETARY: I have felt it appropriate in this, my first annual report, to review the major aspects of the forest situation in the light of post-war needs and to set forth specifically the part which I think the Federal Government must play in providing adequately for the future.

There is reason for satisfaction that our forests have been able to fill so vital a place in the war effort. But there is reason for concern that wartime demands have unnecessarily accentuated forest problems urgently in need of solution before the war.

I believe that Federal forest legislation, including but not limited to regulation of cutting practices on private forest lands, is now more urgently needed than ever before.

In making this statement I am not in the least overlooking or discounting the many examples of good forest management by private owners in almost every forest region. These examples, in fact, demonstrate that good forestry on private land is a practical proposition, except in those adverse circumstances where public ownership is needed.

It is possible that several strong States could shoulder the responsibility for keeping forest lands within their borders productive. But I do not believe that Nation-wide action on such a vital issue as public regulation can be effective if left to the States with no more than financial aid from the Federal Government.

It is my conviction that the complex and difficult problem of developing the productivity and the recreational and watershed values of all forest lands for lasting public welfare will not be solved until Congress enacts a comprehensive legislative charter. Without a clear-cut charter for Nation-wide action, confusion as to objectives and need will prevail, both in Congress and among the people, and progress will be spotty, ineffective, or short-lived.

In forestry there is no panacea. The needs for action are interdependent. The most urgent need is public regulation to stop destructive cutting. But regulation should be supported by an expanded and accelerated program of public acquisition of forest lands to relieve private ownership of responsibility where conditions make this equitable or prudent. And regulation must be supplemented by better protection and by various aids to private owners.

In a situation such as we now face where an important group of landowners must be called upon to conform to certain restraints in order that future productivity of privately owned forests be not further undermined, it is not surprising that conflicts in point of view would develop. Many landowners have forthrightly recognized the

necessity for some changes in the handling of their forest property. Nevertheless, I have found it necessary to take issue with the forest industries on the attitude of complacency with regard to our forest resources which has been reflected in much of their publicity during the past year.

Trips which I have personally made during recent months in a section of Eastern and Southern States, added to my intimate knowledge of the Pacific Northwest and the Lake States, convince me that the situation is one calling for aggressive action rather than complacency.

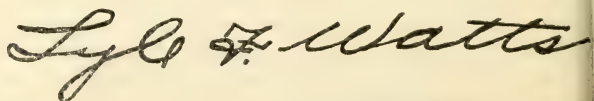
In our democratic country remedial legislation dealing fundamentally with the public interest in private property must be supported by a broad understanding by the general public. I believe that the Forest Service must constantly strive to see that the public is kept correctly informed of the facts of the forest situation, of its social and economic implications, and of what is necessary to assure continued forest productivity.

The public interest in private forest lands is not open to question. Forest conservation involves much more than the growing of crops on forest lands to supply raw material in one form or another for an ever-growing list of uses. Forestry must be coupled with the social and economic welfare of rural communities, especially in regions primarily dependent upon forest industries. Improving forest productivity should mean a great deal to rural America in augmenting the income of farm folk, maintaining pay rolls in small communities and sustaining the tax base to support local government functions.

When I became chief of the Forest Service last January, I found the organization devoting its major effort to war activities. The national forests were being made to contribute to national needs for timber and livestock products as never before. War hazards were giving added significance to the protection of forests from fire. The Forest Service was collaborating actively with the War Production Board and other agencies in facilitating and stimulating the output of forest products for war. Forest Service research was playing a notable part in more diverse and efficient use of wood, in increasing the yield of naval stores, and in more efficient use of the western range for food production. Included in the unusual tasks imposed by the war was responsibility for the growing of guayule rubber to offset in part the cutting off of imports from the Far East. All these activities are proving indispensable in the war effort and will, of course, be continued.

If we are ready to utilize the surplus manpower which may become available in the post-war period, much work that is necessary in developing the productivity and usefulness of the national forests may be speedily accomplished. Accordingly the Forest Service is planning a large volume of useful and constructive work as its contribution to the solution of the reemployment problem, if and when it materializes.

Sincerely,



LYLE F. WATTS,
Chief, Forest Service.

REPORT OF THE CHIEF OF THE FOREST SERVICE, 1943

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FORESTS IN WAR AND PEACE

WOOD IN THE WAR

The indispensability of wood has been convincingly demonstrated by 2 years of war. Wood has been so much in demand for military purposes that urgent civilian needs have been cut to the bone. No longer was it called upon to replace critical metals in many fields when wood itself became a critical material. While the range of utility for wood in its natural state is being expanded by new engineering principles, it is becoming increasingly important as a raw material for a variety of chemical and pulp products.

Shortages of wood have been especially acute in uses requiring timbers of large size and high quality. The utility of wood in meeting the exigencies of war point clearly to the wisdom and necessity of a national policy that will assure ample supplies of high-quality saw timber for the future. Forest productivity in wartime is, therefore, a major public concern from two angles—first, the volume of lum-

ber and other forest products that can be cut for immediate use and second, the rate at which new wood is growing.

Industrial Output Falls Below Wartime Requirements.—The most pressing forest problem before the Nation today is that of obtaining a sufficient output of lumber and other forest products to meet current requirements. In spite of all efforts to stimulate output, lumber cut during 1942, amounting to 36.4 billion board feet, fell some 6 billion board feet short of consumption. Most of the deficit had to be made up from stocks on hand, which by the year end were reduced to a critical low of only about 10 billion board feet.

It is obvious that we cannot much longer continue to draw upon reserve stocks of lumber. From now on consumption will have to be kept in line with production. Inevitably the pinch on civilian use will become more acute. This trend is clearly indicated by a decline in the inventories of retail yards by more than one-third in the first half of 1943, leaving them some 60 percent below the Pearl Harbor level.

How critical the shortage of lumber for civilian use is can be further gleaned from reports that purchases for direct war use in the first 6 months of 1943 were greater than in the preceeding 6 months, whereas estimates of the total cut for 1943 fall some 10 billion feet below 1942 consumption.

Shortage of manpower, particularly of skilled woods workers, continues to be the chief obstacle to larger output. Delays in the procurement of operating equipment and repair parts have also handicapped production in some instances. Thousands of small mills, short of help, lacking the organization to reach beyond local markets, and baffled by price ceilings, priorities, and other regulations, have shut down.

But these factors do not fully explain the production situation. Difficulties of the 45,000 small mills, which account for almost three-fourths of the lumber output in the East and an appreciable though much smaller part of that in the West, point toward an aspect of the problem which the organized lumber industry is slow to admit, namely that depletion of our timber resources is a limiting factor. The very fact that small mills have become so significant in eastern production is a reflection of the virtual exhaustion of old-growth saw-timber reserves and of our dependence upon young second growth, for small mills are characteristic of cut-over and depleted forest regions. Even in the Douglas-fir region some small operators have had difficulty in getting new timber stands to cut.

Beyond that, inability to obtain needed supplies for special uses, such as aircraft spruce, Douglas-fir peeler logs, Port Orford cedar, veneer quality yellow birch, and oak for ship timbers, clearly results from scarcity of accessible timber of these kinds. And no one could doubt that lumber output in the Lake States and the Northeast would be substantially larger than at present, if the forest lands in these regions had been kept more generally productive. Also significant is the fact that in this war we are almost entirely dependent upon Douglas-fir for large structural timbers. Longleaf pine suitable for heavy structural purposes has all but disappeared in the 25 years since the last war.

Wartime Cutting Impairs Future Forest Productivity.—More fundamental and far-reaching than the problem of industrial output is

the impact of destructive cutting on the growing stock left to produce wood for the future in the necessary commercial sizes. Continuity of output requires that the forest land be so managed as to maintain, as forest capital or growing stock, a succession of age and size classes extending up to the dimensions needed for the most exacting uses. Except for virgin timber, annual growth in terms of any class of product varies roughly with the growing stock in trees at or near the size required for that product. It takes more than seedlings and saplings to produce a sawlog. Thus forest depletion becomes a major criterion of forest productivity.

There can be no doubt that forest capital and hence forest productivity are being impaired by the war. Wartime demands have pushed the drain upon the forests 25 percent above the level which prevailed in 1936. High prices and pressure to increase output have combined with scarcity of accessible old-growth timber to stimulate the premature cutting of young second-growth throughout the East and South, and also in some localities of the west. The generally destructive character of such cutting involves a sacrifice of growing stock that will adversely affect usable forest crops for decades after the war and often leaves the land entirely nonproductive. With some exceptions, wartime demands are serving to lower the general level of woods practice on old growth. They are also hastening the liquidation of old growth in parts of the West where available timber and prospective new growth are insufficient to support existing mills for long.

The Nation cannot escape the necessity of cutting all that is needed for war. But it should be concerned that short-sighted destructive cutting practices do not needlessly aggravate the situation, since, for the great bulk of our commercial forest land, deterioration of growing stock means diminished growth of merchantable wood for the decades ahead.

FORESTS IN THE PEACE

Forests are no less vital to the Nation's welfare in time of peace than we now so poignantly realize them to be in time of war. Not alone the myriad uses of wood, but the contributions of forest range to the Nation's food supply; the watersheds that the forests protect; the rest, relaxation, and sport that people find in the forests; all are integral parts of a well-balanced peacetime economy. But in the light of the difficulties in meeting wartime requirements for forest products and the accelerated forest deterioration brought on by the war, major emphasis must be placed now on the steps to be taken to assure adequate timber supplies for the future.

Furthermore, the war, in accentuating the interdependence of the nations of the world, has made us realize that solution of our forest problems must be worked out as a part of the pattern of world-wide well-being and security.

World Outlook Emphasizes Need for Conservation.—Because information on forest resources of the world is so inadequate, and because the war is so greatly affecting the countries about which our prewar information was most reliable, it is possible to make only broad generalizations about postwar production and requirements. Furthermore, questions of finance, shipping, industrialization of undeveloped countries, and foreign policy will influence actual consumption of and

international trade in forest products fully as much as will the availability of the resources and the intrinsic needs for these products.

With entire cities devastated, the normal economy of Europe has been so thoroughly disrupted by the war that the need in post-war years for lumber and other timber products is bound to be great. Not only will there be huge requirements for reconstruction, but a heavy lag in requirements for maintenance will also make itself felt. European consumption is likely to remain on about the pre-war level, however, because none but the former exporting countries will be in position to obtain additional supplies. Practically every country that relies heavily on imports will have to get along with less. Balancing consumption against cut—the latter almost surely being reduced in most of Europe outside of Russia and Sweden—an annual trade deficit of at least 5 billion board feet may be expected.

Neither Asia, with its huge population largely untouched by industrial development, nor Australia—both of them normally importers of softwood lumber from North America—will be in position to meet Europe's need. But from Africa, if transportation be improved, should come larger exports of tropical timber to Europe.

The huge undeveloped hardwood forest of South America may sometime supply world markets with fairly large quantities of timber suitable for construction and industrial use. But for some years any increase in output is likely to be absorbed in South America itself. The Parana pine forests of Brazil, however, may provide an increasing volume of softwood lumber for export.

Mexico will probably continue to draw partly upon the United States, but Canada may be able for some time to increase its exports to Great Britain by about 1 billion board feet a year.

In summary, Europe's post-war timber deficit will probably be greater than the anticipated surplus of all the rest of the world. This coupled with continued demands from Mexico and the Orient, means that our forests are likely to be under continuing pressure to supply more than domestic requirements. On the other hand, there is some question whether we can count on more than a partial restoration of our former imports of pulp and paper from northern Europe, and imports of all forest products from Canada are not likely to exceed pre-war levels.

In this situation the United States must take stock of its present and potential forest productivity. Since we are not now growing as much as we use ourselves, we can safely undertake to help meet Europe's reconstruction needs only as we exercise the utmost care to keep our forest land productive. To put it bluntly, the world outlook accentuates this country's need for an effective forest program. We have enough forest land to achieve a margin for export beyond our own needs. By good cutting practices and adequate protection we must put this land to work more efficiently.

The complexity of the world's timber trade and the exigencies of the situation in war-torn countries pose major questions of national and international policy for the years immediately following the war. They suggest consideration of international action to correlate requirements with supplies and output of the various countries in a manner which will best maintain forest productivity. Without relaxing efforts on the home front, we may well consider the indirect

benefits which may accrue from assistance to other countries in developing their forest resources to help meet world needs.

The prospect of allied initiative in restoring forest productivity in occupied countries, even if confined to the period of military government, brings to the front the question of how effectively the allied powers are regulating their own forest economies. It would seem ironical for the United States, for example, to participate in a far-sighted program of forest restoration in occupied countries while failing to come to grips with destructive cutting at home.

Wood in Post-War Industry.—Domestic requirements for wood will, of course, strongly influence decisions involving our policy in world timber trade. The great impetus that has been given to wood utilization by war conditions may confidently be expected to carry over into the years ahead. The new developments in the techniques of construction seem to assure wood a permanent place as a modern structural material adaptable to a wider range of uses than ever before. New methods make possible the fabrication of large structural members from sawn lumber of the ordinary dimensions and grades obtainable from second-growth timber. They also open the way for radical innovations in building construction which effect great savings of material.

The upward trend in utilization of pulp and paper products has by no means reached the saturation point. For example, resumption of residential construction after the war is likely to be accompanied by a great increase in use of fiber ceiling and insulating boards.

In the field of plastics are large possibilities for the future. Moulded plywood developed for aircraft will doubtless find post-war use in automobiles, furniture, and other articles. The recent development of paper-base plastics further extends the possibilities in these same fields. Moulded plastics, made by chemical processes largely or entirely from low-quality wood or waste, have only begun to find commercial use.

The manufacture of ethyl alcohol offers immediate promise of the utilization of pulp-mill and sawmill waste and the correlative release of more grain for food. Developments in this field point to the possibilities of obtaining alcohol from low-grade wood as a primary process, should this versatile industrial chemical be needed as fuel for internal combustion engines or as a source of synthetic rubber.

But whatever the future may hold for chemical uses, lumber will undoubtedly remain the major commercial wood use in post-war years. For the years of readjustment demands for lumber are likely to be almost as much as the peak output of the war-boom years 1941-42, or of the 1930's. It is reasonable to assume that the upward trend in the residential building cycle interrupted by the war will be resumed and greatly extended. And wood is capable of holding its own as the principal material for residential construction. Farm building and railroad maintenance are likely to reach a high level. Little change is expected in the aggregate of factory uses. Requirements for boxes and crates will probably drop to less than half the wartime peak.

With lumber output maintained at or near wartime levels, and with increased activity in the industries using wood as veneer, pulp,

or chemical raw material, the forests will hold a dominant place in the post-war industrial economy.

Forests in the Agricultural Economy.—A high level of activity in the forest industries can hardly help having a stimulating effect upon the agricultural economy. For one thing almost one-third of the commercial forest land of the country is in farm woods. The outlook offers large incentive to farmers to manage their woodland for maximum sustained yield, either by their own efforts or with the help of cooperative organization. More intensive management of the farm woodlands not only will bring greater income to farm woodland owners and added opportunity for gainful employment to rural communities, but also will establish a dependable source of forest products for home use. It is especially important in the sparsely wooded regions. Difficulties of obtaining the lumber needed for farm use during the war has, in fact, led some of the large farm cooperatives to purchase sawmills in distant regions in order to control their sources of supply.

In order to encourage intensive farm forestry and to assist farmers in most effective marketing of woodland products, the Forest Service has added a series of marketing projects to the services already available to farmers. The technicians working in specific localities under this program have achieved good results in stimulating war production. Similar efforts should be equally constructive in time of peace and should be expanded to serve all farms with commercial woodland.

Forestry in Post-War Employment.—As the Nation looks forward toward the end of war, questions of employment inevitably come to the fore. It is generally believed that cessation of hostilities will bring a period of adjustment and demobilization during which it may be necessary for the Government to provide emergency employment on public works. Satisfaction of pent-up civilian demands for consumer goods and services of all kinds is then likely to be the basis for a few years of industrial prosperity, after which it may be difficult to keep our productive facilities fully occupied. Failure to sustain industrial output may be reflected in widespread unemployment and this may again call for a large expansion of public works.

There is a large volume of essential work on our forests and forest ranges that may be used to expand public employment in times of need. Restoration of forests on denuded or abandoned land by planting; rehabilitation of run-down forests by weeding, thinning, pruning, and other timber-stand improvements; range reseeding; fire-hazard reduction; control of injurious insects and diseases; expansion of forest recreational facilities; and improvement of the wildlife habitat—all call for a large amount of labor with a minimum of equipment or overhead.

There is also need for a large amount of construction for the development, protection, and utilization of public forests. Only half of the road system thus far planned for the national forests has been built or brought to a satisfactory standard. Additional facilities for fire protection are needed in many areas. Adjustments in range management, to make the national forests contribute more fully to the livestock economy of the West under changing conditions, will require new water developments, additional fencing, and other im-

provements. We have only begun the watershed improvement work that is desirable for water conservation and flood control.

Forest and range rehabilitation and improvement work is eminently suited for a post-war public works program because it does not compete with established industry. Instead, it tends to facilitate and enlarge the field for private industry. It opens up new opportunities for economic activity and develops new sources of national income.

Most of this work on forest lands is highly adaptable to changing conditions of employment. It can be quickly started and easily suspended without loss; it is worth while in itself and should be carried forward on public forests as a continuing program in any event. Volume and geographic distribution may be greatly expanded by pushing the acquisition of millions of acres of forest lands which ought to be in public ownership.

The Forest Service is now planning to absorb thousands of men in forest work in the period of demobilization. This planning should be extended and carried forward with increasing intensity so that general agreement may be achieved as to objectives, means, and safeguards, and so that we will be ready with the blueprints and organization required, before it is time to put the men to work.

Looking further ahead, it is worth pointing out that the need for public works depends in part upon the volume of employment furnished by private industry. In communities primarily dependent upon forest industries, the level of permanent employment that can be sustained is directly related to the economic productivity of the adjacent forest land. Far more fundamental, then, than relying on the public forest as a source of employment to provide relief in times of depression, is a forest policy that will contribute to the security and stability of private employment by assuring continued productivity of all forest lands.

FOREST OUTLOOK CHALLENGES THE NATION

If the forests are to make their optimum contribution to national welfare, it will be necessary to provide far better care and management than they have thus far received. An economy of abundance depends upon maintaining the productivity of natural resources at a high level. Yet today, after decades of agitation and educational effort, most of the cutting on private forest lands, which supply more than 90 percent of the annual output of forest products, is done without regard for the future productivity of the resource; and one-third of the private forest area of the country is still without organized fire protection.

Without minimizing the progress reflected in the establishment and development of a substantial area as public forests, in protection of the bulk of the forest land in all regions except the South, and in constructive forestry on perhaps 20 percent of the private forest land, we have failed to come to grips with major aspects of the Nation's forest problem. While expending large sums to protect private forests from fire, insects, and disease, we have failed to prevent destructive cutting. While shouldering huge public outlays for flood control and for relief in problem areas associated with cut-over forests, we have failed to implement in realistic fashion a policy to bring into public ownership lands on which private management cannot be expected to promote the public interest.

Forest Depletion is the Crucial Factor.—The problem faced by this country is not lack of forest land. After 300 years of settlement and development, the forest area of the United States is still more than three-fourths of what it originally was. For a number of years the tendency has been for the area available for forests to increase rather than decrease.

The major problem is to keep forest land productive. Unless aggressive steps are taken nationally, forest productivity will not reach the level of national need. Saw-timber growth, the category that is most critical and most important, is currently not much more than half of anticipated post-war requirements.

There is danger of being misled into a false sense of security by superficially assuming that the increase of annual growth that appears to have taken place in recent decades is bound to continue. The apparent increase is undoubtedly exaggerated by the inadequacy of the information upon which earlier estimates were based and by the more liberal specifications as to what is included in the later estimates. Whatever the actual increase was, it may be attributed largely to the spread of organized fire protection, new growth reaching merchantable size on eastern lands taken out of cultivation generations ago, and the fact that with the culmination of agricultural clearing in the major forest regions an increasing proportion of the land cut over remains in forest use.

Offsetting these favorable conditions, a number of other factors must be considered. One factor, the importance of which has not been generally appreciated, is the disappearance of old growth throughout the East. So long as the major impact of cutting could be absorbed by liquidation of over-mature timber, which was making little or no contribution to growth, young timber reaching merchantable size caused annual growth to increase rapidly. But now that the cut must be largely absorbed by young timber, the increase of productive growing stock is checked and annual growth is adversely affected.

Thus, the remarkable increase of saw-timber growth in the South in recent decades, recorded while the bulk of cutting was still in old timber, cannot be expected to go further without better protection and more widespread forestry practice to bring saw-timber growth in line with drain. And the increase of growth to be expected in the West, as cutting of virgin timber makes a larger area available for new growth, is limited by the low-growth capacity of so much of the area still uncut and by inaccessibility that may preclude cutting of some of it.

Another important factor impairing the basis for future production is the premature and unnecessary stripping of young stands of second growth. Although greatly accelerated by the war, such stripping has long been prevalent in regions where merchantable timber is scarce and is especially serious in periods of active demands for low-value products.

It is more generally recognized that destructive cutting, fire, and indiscriminate grazing are reducing forest productivity. In the South which is destined for such a large place in future production, second-growth forests, on the average are little more than one-third stocked. For the country as a whole, some 77 million acres, or about one-sixth of the commercial forest land, is so inadequately stocked as to be practically idle.

Finally, annual growth is being adversely affected by cumulative reduction of growing stock or productive forest capital. In the last analysis this factor expresses the combined effect of all elements bearing on forest growth other than climate and soil. The extent to which it is operating to undermine the situation has often been overlooked or discounted. People have been little concerned about exhaustion of old-growth timber in the East where three-fourths of the commercial forest land is located, or about serious inroads on the second growth, because it has been possible to draw heavily on virgin timber still standing in the West. Yet the best available statistics, which are more likely to minimize than exaggerate the trend of depletion, indicate that in the period between 1919 and 1938, the volume of eastern hardwood saw timber was reduced 42 percent and that of eastern softwoods 29 percent.

But such general statistics, striking as they are, fail to convey any understanding of how critically the exhaustion of timber supplies is affecting individual communities. To visualize the impact of forest depletion on the lives of the people, it is necessary to get down to the individual worker who wants security in his job and a permanent home for his family.

For example in February 1943, the entire town of Weirgate, Tex., was sold to a wrecking company after a life of only 25 years in which some 100,000 acres of virgin longleaf pine were stripped. Its sawmill and logging and turpentine operations are reported to have provided support for some 2,000 people. Similarly, lack of accessible timber made it impossible to forestall the closing of the last big sawmill in Rhinelander, Wis., at the very time when the Nation's need for lumber was most acute. And the pulp mill operating in this forest community imports much of its wood some 700 miles from Canada.

The people in these communities could gain small satisfaction from the knowledge that in southeastern Arkansas are outstanding examples of sound industrial and community development based on far-sighted private forest management. Nor would their situation be ameliorated by the efforts of a group of landowners in southern Georgia to protect their forest land and develop growing stock for permanent integration of naval stores, lumber, and pulpwood production.

Throughout substantial parts of the East and the Lake States, where much of the land remains in forest, lumber cut has dwindled far below the productive capacity of the land because timber of suitable size and quality is so scarce. Because of continued indiscriminate cutting, this condition is becoming more acute in the East and Lake States, is spreading to the South, and is already a factor in many localities in the West.

Unfortunately, periods of good prices like the present, new uses, and more efficient operating equipment more often lead to destructive cutting than to good forestry practices. The pattern of depletion and deterioration calls for remedial action rather than complacency.

Measures to Assure Adequate Future Timber Supplies.—The fact that we cannot continue indefinitely to cut more than we grow without impairing future yields is not to be evaded, but rather to be accepted as a challenge. Our land resource is adequate; determination to meet the challenge should not fail us. For if steps are taken to improve and build up the productive growing stock by Nation-wide application of good forest practices, annual growth can be increased

to a level which will supply our people and industries with ample timber for all foreseeable needs at reasonable cost, and a margin will be left for export or for emergency use.

The most urgent need is to stop destructive cutting. Only thus can the productivity of every acre now bearing merchantable timber be retained or built up. The Forest Service believes that Nation-wide regulation of forest practices on private land is absolutely essential if needless destruction of productive growing stock is to be stopped. Such regulation should check the premature liquidation of young second growth. By requiring selective cutting in old growth wherever practical, it would gain full benefit from the increment on the thrifty trees of the residual stand.

The need for public regulation is now recognized by many informed people. But conservation leaders are not in agreement as to the responsibility of the Federal Government in such regulation. It is the position of the Forest Service that regulation by State action without strong Federal leadership will not be effective for the country as a whole. Furthermore, it is unlikely that financial aid alone will lead reluctant or strongly independent States to enact adequate regulatory legislation. Neither will it assure a satisfactory level of forest practices. In order that Nation-wide regulation of forest practices may be instituted promptly and be reasonably uniform in standards and enforcement, Federal legislation is needed. This must, as a minimum, prescribe standards for required forest practices and authorize the Secretary of Agriculture (1) to determine whether practices adopted by the States conform to such standards; (2) to inspect enforcement of State laws; and (3) to take direct action where suitable State legislation is not enacted and where enforcement or the practices established are not adequate.

A second means of helping to offset depletion and to increase growth lies in extending and improving protection of forests from fire. In all regions more intensive fire protection will contribute to forest production. It is vital for all lands where timber growing is undertaken as a business by private owners. Authorization for larger appropriations for cooperative fire protection would open the way for more rapid accomplishment in this field. The need is especially great in the South, where less than half of the land needing it has as yet been covered by organized protection.

Other ways in which growth can be increased are by the planting of nonproductive lands and the improvement of young stands by weeding and thinning. Quality will be enhanced by these measures and by pruning. As previously indicated, such forest restoration and timber-stand improvement on public lands constitute a large field of essential public work.

There is also a large opportunity to offset depletion by the elimination of needless waste in the woods and in the manufacture of wood products. Part of this consists in developing uses for species not readily marketed in normal times. Another part lies in such integrated utilization of the timber that, for example, the tops and limbs of trees cut for saw timber do not go to waste in the very locality where potential saw-timber trees are used for pulp or fuel. Progress in eliminating waste is as much dependent upon economic as upon technical considerations. Pilot-plant demonstrations are needed to work out problems of closer utilization and new uses.

The measures which have been suggested to increase forest productivity all add up to more widespread and more intensive practice of forestry. Continuing research is required to guide progress. We need to improve our knowledge of the growth characteristics of important forest types and the response of different species to cultural treatments. We still have only sketchy ideas of how to maintain the more desirable species in the second growth in some forest types, and for many we have not determined the numbers, sizes, and distribution of trees in the optimum growing stock. We have only begun to think of selecting, breeding, and propagating superior stock to improve timber quality or productivity.

In view of the vast program before us, the favorable trend towards forestry in the attitude of some forest landowners and operators is a source of satisfaction and encouragement. An increasing number are adopting plans to keep their lands productive and many are organizing their operations for sustained yield and diversified utilization. The latest expression of this is the "Tree Farm" movement started by important operators in the Pacific Northwest and sponsored nationally by American Forest Products Industries, Inc. While efforts are concentrated on protection from fire and the husbanding of new growth on cut-over areas, some attention is being given also to planning for sustained yield. Some operators have undertaken extensive planting to bring nonstocked land back into production. If this movement is to have real significance, high standards of forest practice must be maintained. Unfortunately, mediocre or lower performance has served to qualify some properties for the "Tree Farm" designation.

In every region there are enough examples of good private forest practice, running all the way from small farm woodlands to large industrial ownerships, to demonstrate that the measures advocated by the Forest Service are practical, save only in those adverse circumstances where public ownership is needed. To encourage and facilitate good forest practice, public aid to private owners should be intensified and broadened in scope. It is only the part of wise administration that such public expenditures be safeguarded by public control of cutting practices on forest lands benefiting from them. Planting stock should be made available to nonfarm as well as farm woodland owners at nominal cost. Technical advice in the preparation of management plans and in utilization problems should be made generally more available. Small owners should have the benefit of the service of competent technicians resident in and familiar with their locality, both for advice on forest practices and for help in the marketing of products. Assistance should also be available for the establishment of small-owner forest cooperatives. Public credit facilities should be broadened more adequately to meet the needs of those striving to build up depleted forest properties and to organize for sustained-yield management. Insurance on standing timber should be underwritten by the Government. Taxation should be adjusted so as not to discourage or impose added handicaps upon those who are holding land for timber production.

In localities where the welfare of dependent communities would be served best by integrated management of national-forest land with interspersed or adjacent private land, cooperative sustained-yield units should be established. In such units the Forest Service should

be authorized to sell national-forest timber to the cooperating owner (at not less than its appraised value) without competitive bids, provided the lands of the cooperator are managed for sustained yield on the same basis as the national forest.

So that the national forests may not fall behind in their leadership in these respects, provision should be made for intensifying their development and management in certain particulars. Of first importance, the ranger personnel must be enlarged to handle properly the increasing volume of work which develops as the forests are more intensively used.

Finally, public acquisition on a greatly enlarged scale by the Federal Government, States, and communities represents the only solution for about 150 million acres of privately owned forest land unlikely to be given the requisite degree of management, even with every reasonable public aid and encouragement to the present owners. This includes not only land now unproductive but also certain areas of merchantable timber, control of which may vitally influence the management of adjacent national forest lands or affect the welfare of dependent communities.

Public Understanding Essential.—In our democratic country remedial action dealing fundamentally with the public interest in private property must be based on a broad understanding by the general public. After 50 years of educational effort, the people are generally unaware of how critical the forest situation is. All too few are informed on the facts of the forest situation, of its social and economic implications, or of what is necessary to put it on a satisfactory basis.

It is unfortunate that a well-financed publicity campaign sponsored recently by the forest industries is designed to cultivate public complacency when destructive cutting is still so widespread. This campaign creates the impression that little not already being done by the forest industries is needed to assure the Nation ample timber supplies for the future. By minimizing or disregarding depletion of growing stock, it misleads the public as to the adequacy of our forest resources. It implies that an inevitable increase of annual growth will take care of all foreseeable needs. It exaggerates the extent and adequacy of the industry's progress in good forest practices.

Since a forthright facing of the facts would be consistent with the alleged objective of the industries, namely "to perpetuate the supply of forest products through sound forest management and to promote understanding of forest ownership and enterprise," one cannot escape the conclusion that this campaign has had an ulterior aim. Possibly this is to ward off public regulation, recommended in one form by the Department of Agriculture in 1940; embodied in that and another form in bills presented in the Seventy-seventh Congress; advocated in still another form by the Joint Congressional Committee on Forestry in 1941; proposed in various forms for legislation in 14 States during the winter of 1942-43; and again brought before the Seventy-eighth Congress in July 1943.

Regardless of the aims of this campaign, education on a national scale is now needed to offset its dangerous misrepresentations. Completion of the Forest Survey, publication of reports, and localization of educational work of public agencies will help. But the solution

also requires and largely depends upon sustained, aggressive interest by all private organizations and individuals motivated by concern for the long-range public welfare.

Needed Legislative Charter.—Three major lines of public action have been suggested: (1) Regulation of forest practices on private lands, (2) aid to forest landowners, and (3) extension of public ownership. Each of these offers opportunity for both the States and the Federal Government. But because forest conservation is so vital for national defense and national welfare, and because the States are so interdependent in regard to timber supply, the principal responsibility rests on the Federal Government.

These three lines of action can only be given full effect through comprehensive legislation. The Department reported favorably on two bills broadening public aid to forest landowners that recently passed the Senate. One of these carries increased authorization for cooperative fire protection; the other authorizes the organization of cooperative sustained-yield units for joint management of federally administered and intermingled private land. A number of other bills representing various approaches to other aspects of the forest problem separately are also before Congress. Because the several lines of needed action are interdependent, it would avoid confusion if a well-rounded national forest policy were embodied in an adequate legislative charter. This would greatly strengthen the foundation for effective and timely post-war action in the forestry field. And a comprehensive forest policy will prove an indispensable element in the structure of security which we hope will mark an enduring peace.

WARTIME ACTIVITIES AND ACCOMPLISHMENTS

During the last fiscal year, as previously, the Forest Service carried the responsibility for a number of important war activities in addition to its regular work. Studies of requirements and supplies of forest products, preparation of specifications and training of inspectors for varied wood uses, the Alaska spruce log project, the aircraft warning service, war mapping, and the emergency rubber project—all challenged its technical skill and administrative resourcefulness.

This additional load had to be carried, however, with constantly decreasing and shifting manpower. Activities not of first priority were so eliminated or reduced to a maintenance basis that personnel could be reassigned or released. By June 30, 1943, some 1,250 year-long personnel were on military furlough, as were an approximately equal number of temporary and seasonal employees on whom the Forest Service had relied for important services in the past.

The following account of wartime activities and accomplishments is necessarily sketchy. It shows, however, that many Forest Service activities are vitally needed in the war program and illustrates how the organization has been able to adapt itself to war needs. Necessarily it omits an accounting of certain indispensable lines of work which were not characterized by noteworthy developments during the year.

FOREST FIRE PROTECTION VITAL IN CIVILIAN DEFENSE

Many factors necessitated more intensive forest-fire protection during the past year. Among these were the need to prevent diversion of men from war industries and farming to forest-fire fighting; the importance of uninterrupted operation and protection of power plants, transmission lines, railroads, industrial plants, and other facilities in forested areas; the need to avoid smoky atmosphere which might handicap defense against submarines, lower the efficiency of the aircraft-warning service, and interfere with air travel and pilot training; military installations and the presence of large numbers of soldiers in and near forested areas; and the threat of sabotage. Two instances of enemy incendiary bombing occurred in the forests of western Oregon. Fortunately neither resulted in serious fires.

In recognition of this dangerous situation Congress again supplemented regular appropriations with emergency funds based on Federal-State surveys and plans. A total of \$12,212,000 was available during the year. About half of this was expended on the national forests and the rest for cooperative protection of State and privately owned lands. This served to protect the danger spots but left unprotected, as in other years, about a third of the entire area needing organized protection, mostly in the South. Fires in the South were particularly wide-spread during the spring of 1943.

The 1942-43 fire record reflects a fairly favorable season in most of the critical western regions. However, because conditions got out of control in the South and because of unusually large fires resulting from the unprecedented early drying of luxuriant cheatgrass in the California foothills and the Intermountain region, the acreage burned was substantially in excess of the five-year average.

Drain on Experienced Fire-Control Personnel.—The fire-protection agencies were handicapped by continued loss of experienced fire-control personnel to military service and war industries. This was further aggravated by the complete liquidation of CCC camps, which had previously furnished a large part of the trained fire-fighting labor. Offsetting this loss in a limited way was the availability of some 2,000 men classified as conscientious objectors under the Selective Service Act, who were assigned to Forest Service camps for work of national importance under civilian direction in lieu of induction into the military or naval forces. Further needs of the fire organization on the national forests were met by the employment and training of high school students, principally of the 17-year-old class and by more extensive use of women. The training of a large number of raw recruits for fire duty was facilitated by carrying through the winter, on other employment, a limited number of experienced and tested fire guards.

To offset the loss of regular forest-protection employees, the Forest Service and the State forestry departments continued the organization and training of volunteer fire fighters as an auxiliary service within the Office of Civilian Defense.

Further to meet the manpower shortage, cooperation was obtained with the Army for the suppression of forest fires near training locations or combat stations. This cooperation was expanded in the

spring of 1943 by an agreement under which the Army takes all reasonable precautions against the starting of fires on military reservations as well as assisting in their suppression.

Under a cooperative agreement with the Office of Civilian Defense, the personnel and aircraft of the Civilian Air Patrol continue to be available for forest-protection work when needed.

Forest-Fire Prevention.—With the cooperation of the War Advertising Council, State foresters, civic and conservation associations, women's and young folks' organizations, and many other groups, business enterprises, and individuals, the Forest Service continued in 1943 the intensified educational campaign for preventing forest fires throughout the country which had been so well received in 1942. The need for such a campaign was greater than ever, because of the curtailed control force and the lack of experience of the men available.

Research Aids Fire Control.—Research technicians have been of great help to fire-control organizations in planning to meet the fire situation in key defense areas. In addition to assistance in the preparation of special fire-control plans for such areas, forest research furnished fire-danger meters to cover additional forest types; located, installed, and serviced fire-danger measurement stations; assisted in defining standards for fuel-type mapping; and developed a man-dispatching meter.

Significant Developments in Fire Control.—As an outgrowth of experimental work dating back to 1934, parachutes have been used successfully by the Forest Service to drop men and supplies from airplanes for prompt attack on fires in remote and inaccessible areas. This is now a regular part of the protection plan in the Pacific Northwest and Northern Rocky Mountain regions. Starting with 16 specially trained smoke-jumpers in 1940, the number was expanded to 24 in 1941 and 40 in 1942. This year the number has been increased to 80, including 60 volunteers from Civilian Public Service camps.

Motion pictures produced by the Forest Service are proving valuable tools in the training of recruits for the fire-control organizations. Use is also being made of a War Department film on military training which illustrated methods readily applicable to fire organization, training, and practice.

The Forest Service is following closely the development of military equipment which may be adapted with advantage to Forest Service use at the close of the war. A one-quarter-ton, four-wheel-drive jeep, tested on the Clark National Forest in Missouri, proved to be superior to conventional trucks of similar or larger size for the transportation of fire fighters, equipment, and supplies over difficult terrain having poor roads or none at all.

Aircraft Warning Service.—The Federal and State forest services' network of fire lookout stations has played an important part in the Army's far-flung aircraft warning service for the protection of vulnerable areas from enemy air attack. The number of stations manned 24 hours a day by observers trained for aircraft detection was expanded to 671 as of June 30, 1943. Arrangements continue for the instant integration of the national-forest communications facilities with the military system in the event any specific war emergency should involve national-forest areas.

NATIONAL FORESTS TAKE IMPORTANT PLACE IN
WAR ECONOMY

National-Forest Timber in Increased Demand.—The cut of national-forest timber, amounting to 2,359,473,000 board feet, exceeded that of any previous year. It was 83 percent more than 1939, the last year unaffected by war demands. Receipts from sales and trespass, and value of timber cut under land exchange agreements also reached an all-time high of \$9,507,376.

The increased cut on the national forests was due in part to a growing scarcity of accessible privately owned timber and in part to special efforts to make national-forest timber help in the war effort. Special authority was obtained to speed up the sales procedure by reducing the time required for advertisement. Authority was also obtained to sell timber without competition when this would promote the war effort. In addition, construction of access roads was undertaken to open up urgently needed timber. The keen interest and untiring effort of the personnel also helped to keep the national-forest timber cut on an upward trend.

By opening up new stands and by the utilization of trees and species ordinarily considered unmerchantable, the increased cut has been obtained in all but a few localities without exceeding sustained-yield cutting plans. Nowhere have communities dependent upon the national forests been jeopardized by excess cutting for war purposes.

Perhaps the most dramatic war contribution is the Alaska spruce log program, undertaken by the Forest Service at the request of the War Production Board, to obtain Sitka spruce for aircraft construction from the Tongass National Forest. Logging, financed by the Commodity Credit Corporation, is being done by contractors operating from nine camps established for the purpose.

The first raft of airplane spruce logs was delivered in Puget Sound in January. The yield of aircraft-quality lumber from the Alaskan logs is exceeding all expectations. Hemlock and spruce not suitable for aircraft are being sold to Alaskan mills to augment the lumber supply for the armed forces in the Territory. Including these, output during the summer reached 8 million board feet per month.

Shortage of personnel made it imperative to discontinue or curtail much timber-management work on the national forests. Improvement of timber stands by removal of worthless cull and weed trees, normally done immediately after logging, has been curtailed or postponed. Forest tree planting has been practically suspended for the duration. In the Lake States, however, treatment of established plantations to prevent choking out by weed trees and brush was continued where labor was available. Substantial loss of the original plantations was thus prevented on some 80,000 acres out of 255,000 urgently in need of release from weed competition at the beginning of the year.

In cooperation with the Bureau of Entomology and Plant Quarantine, control work continued on a restricted basis against the white pine blister rust and tree-destroying insects. Lack of labor was partially overcome by using high-school students and other youths of pre-draft age. A total of 109,857 acres, about equally divided between the East and West, were worked by ribes eradication crews. Some 1,248,000 acres of the control area remained unworked as of January 1, 1943.

For bark beetles it was only necessary to maintain one major control project—in the Wasatch Mountains of Utah.

Good Management Is Key to Increased Yield on National-Forest Ranges.—The number of livestock grazing on the national forests did not vary materially from the previous year. Receipts from grazing, however, rose almost 24 percent to \$1,973,233 as a result of an increase in fees incident to changing market prices. Because of manpower shortage and unskilled cow hands and sheepherders, an extra burden of supervision has been placed on the forest officers. Furthermore, shifts from sheep to cattle and other changes in range use have involved considerable revision of range-management plans.

Wartime requirements for beef, mutton, wool, and hides emphasize the importance of maintaining the productivity of national-forest ranges. In World War I, grazing of excessive numbers of cattle and sheep failed to produce the desired increase in yield and severe damage was inflicted on much of the range, some of which has not yet fully recovered.

Experience with overgrazing in World War I and knowledge gained from subsequent research indicate that the national-forest ranges will make their greatest contribution through better management. Thus, in this war, improved practices are being relied upon to obtain maximum sustained output of meat and to safeguard future forage production. Both these aims are vitally important for the long pull ahead, whether it be a prolonged war or a heavy post-war demand for livestock products in world-wide rehabilitation.

Proper stocking insures that livestock gain weight rapidly and remain in good flesh. Furthermore, livestock men are being urged to market their animals before gains level off or losses in condition occur. In general this means earlier marketing with greater weights of animals coming from the national-forest ranges and a better use of the forage resource.

Continued meetings and field discussions with the 800 national-forest livestock associations and advisory boards help in a better understanding of current problems and policies by all concerned.

Management of the forage resources on national-forest lands is inseparable from the management of those lands for timber production and other purposes. Only because the Forest Service has full control of all uses can its administration give proper recognition to all the demands and services which the lands within its jurisdiction may fill. Conflict of authority and public confusion would be inevitable if responsibility for different functions on the same land were lodged in more than one agency.

Greater Use of Some Wildlife Resources Desirable.—The problem of utilizing big-game surpluses on certain national forests has been accentuated by wartime restrictions on travel and on the quantity of ammunition available for civilian use. Every effort is being made in collaboration with the States to reduce the numbers of deer and elk where undesirable surpluses exist. Unless the herds can be adjusted to the grazing capacity of the range, forage resources will be further impaired and surplus game animals will fall, not to the hunter, but to disease, predators, and starvation.

Failure to harvest the normal increment of big game in wartime is doubly unfortunate. It means a loss of some 30 million pounds of

meat to the Nation's food supply—that amount being the kill from the national forests in 1942. And the War Production Board is anxious to have deer hides made available to the tanning industry for the manufacture of soft leather goods needed by the Army. During the 1942 season about 160,000 deer hides were obtained through cooperation of State conservation departments and other agencies. Within the national forests the Forest Service helped in this campaign.

Based on experience following World War I, it is anticipated that the post-war demand for hunting and fishing will greatly exceed pre-war levels, taxing especially the fishing resources of the national forests which are always enjoyed by several times as many individuals as are the hunting privileges. There will be need for well-planned programs of fish management in cooperation with the States and the Fish and Wildlife Service. Greater use of wildlife resources will focus attention on the need for improvements and betterment projects discontinued during the war, including construction of small ponds, fish-rearing stations, protection and propagation of important food plants, and improvement of cover conditions for quail, ruffed grouse, etc.

National Forest Recreation and Occupancy.—Prior to the war much had been done on the national forests to provide the public with simple facilities for wholesome outdoor recreation and low-cost vacations, notably in the development of 4,258 camp and picnic areas, 201 swimming areas, 254 winter-sports areas, 54 organization camps, and 11 hotels and resorts.

With the growth of winter sports the national forests have become practically yearlong playgrounds for the public. In the calendar year 1942 there were almost 1 million recorded visits to winter-sports areas, as compared with over 5 million to camp and picnic grounds.

The war has greatly curtailed use of national-forest recreational facilities, the majority of which were taxed to capacity before the war. It has also made it difficult for the Forest Service to supervise and maintain these facilities. Recreational use in 1942 was in general only about 60 percent of the volume of the previous year. Nevertheless, and despite extensive reductions in fees for those in war service, the receipts from special uses, consisting largely of recreational items, increased about \$5,900.

In addition to transient recreational use and to the large population resident upon private lands within national-forest boundaries, some 2,500 families actually reside upon and derive their major economic support from national-forest land. In most instances these families occupied the land when it was acquired by the United States. Experience has shown that, with reasonable assistance in the rehabilitation of their homes, fields, and facilities, these families can maintain a degree of economic independence sufficient to obviate need for direct relief in time of depression.

Engineering Facilities Serving War Needs.—With regular development and construction programs largely laid aside for the duration, the engineering staff of the Forest Service has been busy with war activities. Foremost of these has been work on 103 construction projects, involving about 1,200 miles of road, to make accessible for immediate use timber and strategic minerals located within the national forests.

The Forest Service has cooperated with the armed service in developing special equipment needed for military operations. An out-

standing contribution is a very small crawler-type tractor originally designed by the Forest Service for trail construction. This has been adopted by the Army for air-borne construction units destined to provide or repair air fields, trails, and roads at advanced bases. A two-track snow tractor, designed and successfully operated by the Forest Service for hauling pay-loads up to 3,000 pounds over deep snow in mountain country, is also being considered for military use.

Practically all regular surveying and mapping were suspended to expedite delivery to the War Department of large-scale, precise, topographic maps of two tracts in California, aggregating 4,345 square miles. Additional work of this kind in the East is now being undertaken for the War Department. A large amount of aeronautical-approach mapping and of photograph and map-enlargement work has been done for the Air Service.

Accumulated demands for aerial photography and accurate maps needed for the protection, development, and administration of the national forests, and the extraordinary maintenance and betterment that will be required to bring forest roads and trails up to a satisfactory standard, will call for resumption of regular work on a much larger scale as soon as the situation permits.

National-Forest Watershed Management Proves Its Worth.—Although curtailed because of wartime restrictions, the Arroyo Seco flood-control project in the Los Angeles River watershed aided in reducing damage from heavy January storms. While the benefits from all mechanical and vegetational control measures could not be quantitatively measured, a major channel barrier is known to have stabilized some 250,000 cubic yards of channel debris, which otherwise would eventually have been moved into the Devils Gate reservoir protecting Los Angeles. During the same storm period, flood-control works installed in the spring of 1941 are reported to have effectively protected home sites and public utilities along the Santa Ana River near San Bernardino, Calif.

Erosion studies and flood-control survey reports now on file constitute the basis for projects that may be quickly initiated in many of the national forests in a broad program of post-war public conservation work.

National-Forest Land Acquisition.—War conditions have compelled deferment of the program of Federal forest-land acquisition, which has been evolved through the study and experience of the past quarter century, but every reliable indicator emphasizes the fact that such a program must be resumed on a large scale, at the earliest practicable date, if the requirements of the post-war era and of permanent forest economy are to be met. Within the national forests and purchase units hitherto established are more than 36 million acres of private forest land that must be in Federal ownership if the public forests are fully to serve the public needs at minimum costs. Outside of existing national forests and purchase units are more than 50 million additional acres for which a national-forest status is indicated by considerations of permanent public interest and welfare.

During the year, consummation of previously approved cases resulted in purchase of 198,784 acres and donations of 9,311 acres. In addition, title to 280,201 acres was acquired in exchange for timber valued at \$1,314,624 and 52,161 acres of national-forest land. While approvals of new purchases were insignificant, 172 exchanges, which

will bring some 300,000 acres into national-forest status, were approved during the year.

RESEARCH FOR WAR AND POST-WAR NEEDS

Most forest research is today reoriented to war objectives, and appropriations for regular work have been greatly curtailed. It is well to consider whether the post-war and long-time public interest is served by such curtailment, since it constitutes a major interruption of efforts to provide technical information that will be urgently needed after the war, if we are to use wisely the forests comprising one-third of our total land area. It is characteristic of the American temperament to go to extremes. Today we appear to be sacrificing long-range values that even hard-pressed Russia and England are striving to maintain. For example, it was somewhat anomalous, in the light of drastic curtailment of our research on forests in relation to stream flow, to entertain during the past year a delegation of scientists sent from Russia to discuss problems and techniques in this field, incident to re-establishment and continuation behind the lines of research formerly carried on in areas occupied by the Germans.

Forest Products Laboratory Active in War Work.—For nearly 2 years the Forest Products Laboratory has concentrated on the research and technical services required for the selection, production, substitution, and efficient use of forest products for war and essential civilian uses. The extent and variety of the Laboratory's activities during the past year are indicated by the following examples:

Information needed in the war effort was incorporated in 50 reports on the properties and uses of wood, plywood, and paper base and wood base plastics in aircraft and other war products. Specifications for spruce, yellow poplar, Douglas fir, and western hemlock aircraft lumber, for aircraft plywood and for the kiln drying of aircraft lumber were revised. The Wood Aircraft Fabrication Manual prepared last year for the Aeronautical Board, was revised to include the latest Laboratory information on the preparation of materials and the operations essential to the manufacture of wood airplanes and gliders.

The job of solving the packaging, loading, and shipping problems for all Army Ordnance equipment and supplies was expanded many fold. Containers were designed for hundreds of articles including antiaircraft guns, armored trailers and cars, ammunition, mobile shop trucks, rifles, and "bazookas." Besides providing protection to ordnance supplies in overseas shipment, large savings in packaging materials and cargo space are being made. A great many commercial greaseproof and waterproof papers were tested to determine their suitability for wrapping ordnance equipment for overseas shipment. Assistance was also given manufacturers, lend-lease, War Food Administration, and the Army Air Forces in solving their packaging and shipping problems.

Training courses for packaging inspectors of the armed forces were given 61 times to a total of 2,900 people. Other instructional courses covering the repair, maintenance and inspection of wood aircraft; the inspection of wood ship construction; and the manufacture of veneer and plywood, were attended by a total of 710 people in 24 sessions.

Assistance was given the Navy in preparing specifications for low-temperature phenolic glues; fire-retardant paints, chemicals, and treatments; a water-repellant preservative; and plywood for naval use. The Navy was also aided in solving problems relating to the finishing of plywood for advance base huts and to its protection from delamination and decay. First-aid kits for the use of the Army Ferry Command in arctic and tropical service were redesigned; assistance was given the Quartermaster General's Office in the design and construction of Army cots; and a nonmetallic spring for land mines was developed at the request of the War Production Board. Samples of a wood product pliable at ordinary temperatures were submitted to the Army for tests in special types of footwear.

At the request of the War Production Board a pilot plant was set up to gain experience with a process now used extensively in Germany for the production of ethyl alcohol or high-protein livestock feed from wood waste and low-quality timber. The results to date have been highly satisfactory. A number of other chemicals of military importance, such as glycols, tar acids, hydrocarbons, naphthene, and heavy oils with high boiling points, can be derived from the lignin available in sawmill and pulp-mill wastes.

The Laboratory developed a rifle hand-guard blank made from moulded plywood which does not tend to split and char as solid walnut does, requires less wood, and costs less to manufacture.

The feasibility of gluing smooth sawed surfaces of aircraft woods was demonstrated. By this practice the yield of aircraft lumber from a given log can be substantially increased above that obtained by rough sawing and planing. The labor required per finished part is also reduced.

Papreg, the high-strength resin-impregnated paper plastic developed at the Laboratory, was adapted to many commercial uses, including equipment cases, aircraft parts, and parts for gun turrets. Further experiments show that low-cost lignin, recovered from waste pulping liquor, has possibilities as an extender or substitute for the critical phenolic resins commonly used in paper plastics.

The results of tests of a truck equipped with a wood-gas generator utilizing charcoal as a substitute for gasoline were made available to Government agencies placing contracts for China. Consulting aid was given to numerous manufacturers in the use of wood for products formerly made of steel, including manufacturers of office equipment, lighting fixtures, radiators, bed springs, mattress frames, carpet sweepers, factory truck wheels, and tires.

Many of the Laboratory wartime contributions will be of permanent value in widening the field of wood use and improving its serviceability.

Research Helps Increase Naval Stores Production.—War demands for turpentine and rosin have exceeded production, and stock piles of these materials, particularly rosin, have dropped to low levels. Labor and material shortages have made it impossible to meet wartime needs by the usual production methods. However, Forest Service research offers a partial solution of the problem in chemical treatments giving higher yields per tree with very little increase in labor. By application of sulphuric acid to freshly chipped streaks, the interval between chipping may be doubled without reducing the

yield of gum. Where ample labor is available for the usual weekly chipping, yields may be greatly increased by treatment with a caustic soda solution. Increases of yield averaging 17 percent have been obtained in commercial operations using these methods. Experimentally, increases from 35 up to 125 percent have been obtained.

Substantial progress has also been made in the selection and propagation of strains of pine giving unusually high gum yields. Individual trees yielding between two and three times as much gum as their associates of the same size and vigor have been segregated. Methods by which cuttings from such trees can be rooted have been worked out. For young slash pines 90 percent successful rooting has been attained, but from mature trees only about 20 percent successful rooting has thus far been obtained. This work, sharply curtailed because of reduced funds, offers immense promise for the post-war period in that it may enable gum naval stores to compete successfully with mineral oils for certain large markets hitherto closed to them.

A study of the effect of forest fire on naval stores yields has led to recommendations as to how controlled fires may be advantageously used in naval stores management.

Camouflage Planting Research Has Permanent Value.—Although the favorable progress of the war has reduced the interest of the Army and Navy in planting research for camouflage purposes, the Forest Service continues to furnish advice and guidance along this line to military units. In addition, some of the research undertaken to meet military needs is uncovering leads which should be of post-war importance. Treatments that increase survival under adverse conditions, chiefly by reducing transpiration, may permit planting to be carried on at almost any time during the growing season. This would greatly enlarge the amount of needed reforestation which could be accomplished during periods when surplus labor may be available.

Other planting research leads, which might add materially to the effectiveness of post-war public-works projects on forest lands, include methods of direct seeding to speed up reforestation and reduce the cost. Timber-stand-improvement research prosecuted now may also facilitate post-war programs, especially in the treatment of cut-over areas and well-established pole stands.

Research Points Way to Better Range Use.—The value of range research in the war emergency has been emphasized to both stockmen and agencies managing public lands. Largely as a result of research findings, better range conditions and conservative utilization of forage are now recognized as essential for greater production of meat, leather, and wool. The time to market range livestock in order to obtain the most meat, for example, is related to the maturity of range forage and the degree of its utilization. Supplementing work previously done for other types, criteria for judging range condition and forage utilization have been developed during the year for subalpine and mountain-meadow ranges of the Pacific Northwest, annual type ranges of California, semidesert ranges of the Southwest, and short-grass ranges of the Great Plains.

A better understanding of the use of protein supplements in promoting more efficient utilization of range forage has been attained. The possibility of much greater beef production from the range cattle industry of the Southeast is indicated by cooperative experiments in

the States of North Carolina and Georgia. Range cows, whose feed was supplemented with cottonseed meal during fall and winter, grazed the native forage more freely and gained 22 pounds, while cows without supplemental feeding lost 81 pounds. The experimental herds produced a 91 percent calf crop this year in contrast to 40 percent from herds handled under customary practice on comparable forest ranges.

A field check of range reseeding in the Intermountain region shows that careful seeding of selected sites is justified financially and that such seeding holds promise of increasing 6 to well over 10 times the grazing capacity of millions of acres of depleted range land. During the past year its research on artificial range reseeding has enabled the Forest Service to fill urgent requests for detailed planting instructions for concealment, dust control, and fire-hazard reduction on Army and Navy bases, both at home and in theaters of foreign combat.

Concluded with highly practical results were two studies relating to sheep range. In one case, methods were tested and perfected whereby dense sagebrush range can be safely and beneficially cleared by burning, resulting in simplified handling of sheep and increases in grazing capacity of 70 percent or more. These results are in strong contrast to the serious damage commonly resulting from haphazard burning of sagebrush ranges. Other studies have worked out management practices by which sheep may make safe and profitable summer use of ranges infested with orange sneezeweed. This poisonous plant now causes an estimated annual loss of \$150,000 in Colorado alone. Under the improved grazing practices, lambs weighed 10 percent more at marketing time, income from lambs increased 45 percent, and death losses of ewes from poisoning were only one-sixth as much as occurred under prevailing methods.

Forests and Stream Flow.—Ability to forecast stream flow aids in the efficient operation of reservoirs. It is especially important in this war, when hydroelectric plants must be operated at maximum capacity and when food production may be increased by optimum use of irrigation water. Investigations on the Coweeta Experimental Forest in western North Carolina, relating the behavior of streams from watersheds under various cover conditions to the fluctuation of groundwater levels, have developed a method of forecasting the flow of large rivers. Predictions of stream flow made by the Appalachian Forest and Range Experiment Station are being used by the Tennessee Valley Authority and private power companies in the Appalachian Mountain region as a basis for operating reservoirs for maximum power production. In the Southwest, predictions of the runoff from mountain watersheds are based upon the behavior of certain streams in the Sierra Ancha Experimental Forest. These predictions have been within 15 percent of the actual water yield. With greater refinement in the methods used, a much closer forecast should be possible. The value of such forecasts is incalculable to the irrigationists of the Southwest, who are completely dependent upon the availability of water.

Such relations as these help define the place that forestry should take in upstream flood-control programs for the post-war period. Because of the war situation, however, surveys of watersheds to determine what could be done on the land in the interest of flood control were discontinued on June 30, 1943. During the year the Forest

Service completed the field surveys of those watersheds which had been assigned to it, including the Yazoo, San Diego, Santa Ynez, Sevier, and White (Arkansas and Missouri) Rivers. Altogether the Forest Service has prepared reports on 15 drainages. The report for the Los Angeles and the Little Tallahatchie (Mississippi) watersheds have been published as House documents.

Reduced appropriations have necessitated the closing of forest influences research by both the Lake States and the Southern Forest Experiment Stations. The work of the former was concentrated largely at La Crosse, Wis., and of the latter on the Irons Fork area in Arkansas.

Progress in Forest Economics Investigations.—During the year Forest Service assistance in the making of a comprehensive forest-tax investigation was requested by Florida. Proposals for legislation to provide for payments to local government, in lieu of taxation of federally owned conservation lands, drew extensively on the time of forest-taxation experts in the Forest Service. Study of the subject culminated during the year with the issuance of the Federal Real Estate Board's report, "Federal Contributions to States and Local Government Units with Respect to Federally Owned Real Estate" (House Document 216). The recommendations of the Board with respect to conservation lands of this department were based on and are wholly consistent with the contributions plan developed primarily by the Forest Service.

In spite of operating difficulties, labor shortage, and the pressure of other farm work, the farm forest cooperative at Cooperstown, N. Y., sponsored as a pilot plant by the Forest Service, turned out almost 2 million board feet of lumber, most of which was channeled directly to war uses. Community interest and support for this project have become stronger and plant operations have been modified and adapted to wartime exigencies. A report on a recent study in collaboration with the Bureau of Agricultural Economics showed that, on farms with from 20 to 50 acres of merchantable woodland in good condition, participation in the forestry program of the cooperative provided 23 percent of all net cash farm income.

The Nation's problem of how to harvest more and better forest products, yet keep forest lands in condition to meet post-war needs, has been the focus of a widening circle of attention. The completion during the year of the first comprehensive report on the results of the investigations in this field on the experimental forest at Crossett, Ark., is a landmark. The economic practicability of partial short-interval cutting in the shortleaf-loblolly type is being demonstrated conclusively; remaining to be made are further investigations of the comparative economic advantages of cutting cycles of different lengths and of other alternative management and utilization practices.

Field inventory work in the Nation-wide forest survey which the Forest Service has had under way for several years has been largely suspended during the war. Earlier work, however, provided the basis for reports published during the year on forest resources and industries of Georgia, Louisiana, northern Idaho, and the ponderosa pine region of Oregon and Washington. Other reports dealt with probable timber requirements for farm buildings, for cooperage, and for shipping containers.

COOPERATION WITH WAR PRODUCTION BOARD, OFFICE OF PRICE ADMINISTRATION, AND OTHER WAR AGENCIES

Surveys of Requirements, Supplies, and Production of Forest Products.—Through arrangements with the War Production Board, Office of Price Administration, and other war agencies, the Forest Service continued to conduct surveys and render technical assistance on problems involving forest products. The supply of lumber and other forest products has progressively become more critical, resulting in a growing need for adequate statistics on requirements and supplies, and for technical information concerning production and distribution. Most of the time of the Forest Survey staff was devoted to this work.

Among the statistical surveys completed or in process, chiefly through the forest experiment stations, are a 100-percent canvass of 1942 lumber production in cooperation with the Bureau of the Census; a monthly survey of lumber production; monthly surveys of production and shipments of aircraft and other specialty-product lumber; quarterly surveys of lumber stocks on hand at sawmills, and a special survey of stocks at retail, wholesale, and concentration yards. Canvasses were also conducted to determine total capacity of dry kilns, the possibilities for production of wooden barrels for rosin containers, and costs of producing pulpwood in the Lake and Northeastern States.

Periodically, exhaustive reports were made on the factors retarding lumber production. Assistance was furnished the War Production Board in analyzing and forecasting requirements for lumber and other forest products, and several agencies were aided in preparing their claims in accordance with the War Production Board's program.

Two members of the Forest Service were included in a four-man WPB timber mission to England to consult on that country's war needs for wood products.

War agencies called upon the Forest Survey repeatedly for information on the volume, quality, and availability of timber, especially critical species, such as yellow birch, yellow poplar, sweetgum, noble fir, and Sitka spruce.

The possibilities of increasing the domestic production of special products, such as shuttle blocks and picker sticks for the textile industry, were investigated. Reports of veneer and plywood manufacturers were analyzed to determine equipment being utilized, production capacity and yields of veneer and plywood from various sizes and grades of logs.

Studies also were made of needed logging equipment and repair parts, and of means of handling more efficiently the transportation of logs and bolts from stumps to point of manufacture. Grading rules for aircraft lumber were developed. Analyses were made of log and lumber grades relative to area pricing controls.

Measures to Stimulate Output of Lumber and Other Forest Products.—As production of lumber lagged during 1942, it became clear that unusual measures would have to be taken to stimulate output, particularly from the thousands of small mills in the East. In collaboration with the War Production Board, the Forest Service outlined a proposal which would utilize its far-flung field organization for this purpose.

This plan was violently opposed by the lumber industry which claimed that it might involve the Government in the lumber business and become a vehicle for imposing Government regulation of forest practices. Industry spokesmen asserted that no need existed for the services suggested. After a long delay during which some of its salient features were adopted in whole or in part, the original plan was dropped. However, the need for additional effort to maintain output of forest products remained acute and a modified plan, whereby the Forest Service might be called upon to undertake certain functions for the War Production Board, was eventually approved.

The main features of the plan, which is now in operation in a number of eastern States, include service, especially to small operators, in meeting the many inevitable procedures incident to total war; aid in getting timber for mills not now adequately provided with standing timber; aid in obtaining firm contracts for logs and lumber, thus enabling operators to obtain adequate finances, primarily through private sources; and technical guidance to operators to assure efficient use of available manpower and facilities. The President approved this plan with the understanding that where Federal financial aids are advanced, there must be provision to prevent destructive forest practices.

Another phase of the War Production Board's drive for more timber production involved cooperation of the War Food Administration and the Forest Service to encourage an increased harvest of forest products from farms. The War Food Administrator requested State and County Agricultural War Boards to direct local efforts to reach every farmer having timber that might properly be cut and to arrange for the assistance of technical foresters where desired to guide forest practices and facilitate marketing.

FARM FORESTRY

Farm Woodland Marketing Projects and War Production.—In harmony with the War Production Board's efforts to stimulate lumber output, the Forest Service, using funds available under the Cooperative Farm Forestry Act, assigned farm foresters to 76 marketing projects involving 285 counties in eastern States. These projects are carried out in cooperation with the States and are State-directed in all but 8 cases. They supplement, with especial emphasis on marketing, 10 forest-farming demonstration projects previously established. The service includes estimating the quantity of timber ready for removal, marking trees to be cut in accordance with good silvicultural practice, providing a simple form of sale agreement, and aiding the farmers to obtain competitive bids from timber operators and millmen. While the primary purpose behind this assistance is to convince farmers that woodland is a valuable asset in the farm economy and that it can be so managed that it will yield revenue at relatively short intervals, in much the same manner as livestock, orchards, or field crops, these projects have been instrumental in stepping up lumber production locally and in channeling the farmer's timber to essential war industries.

The program has proved popular with both farmers and purchasers. The farmers find markets which have brought from 50 to 200 percent more for their timber than under the usual lump-sum sale practice,

and their woodlots are left with a good stand of thrifty trees. The purchasers are kept posted as to where stumpage can be obtained and the kinds of timber available.

Farm Forestry Extension.—The Forest Service cooperates with the Extension Service in the farm forestry educational program. During the last fiscal year, 43 State extension services and 2 Territories carried on this work, employing 57 extension foresters and assistants. Federal funds disbursed to States totaled \$88,490. The States provided \$129,853; thus the effectiveness of the Federal appropriation was more than doubled.

In addition to work similar to but not duplicating the woodland marketing projects, extension activities include woodland protection, tree planting, fence post treatment, and 4-H Club work. Special effort was made the past year to assist in the marketing of farm forest products needed for the war program, and in farm fire protection. In more than half the States, extension foresters headed up or were on the committees responsible for the emergency rural fire-control project, which helped to reduce farm fire losses by some 10 million dollars.

COMMUNITY FORESTS

Preoccupation with the war has not caused any apparent decline in the public interest in community forests. Latest reports to the Forest Service show a total of 2,203 community forests with a combined area of 2,873,762 acres, as compared to 1,687 forests with an area of 2,604,000 reported a year ago. There is every indication that there will be a marked increase in this phase of forestry after the war. Post-war planning in a large number of municipalities and rural communities includes the establishment of community forests, which may help solve local problems of unemployment relief and improve the community environment, educational facilities, and health conditions.

NEW ENGLAND TIMBER SALVAGE PROJECT NEARS COMPLETION

By the end of 1943 the project for salvaging the timber felled in New England by the hurricane of September 21, 1938, will be brought to a close. Delivery to purchasers of 162 million board feet of lumber and 28 million feet of logs during the last fiscal year left only about 18 million board feet of lumber and 10 million board feet of logs in the hands of the Government.

In this project more than 660 million board feet of logs and almost 60 thousand cords of pulpwood were salvaged. Under a program organized within a few days after the hurricane, logs were purchased from landowners at 844 receiving stations scattered throughout the 14-million-acre hurricane zone. The program enabled 13,568 landowners, mostly farmers, to receive fair prices for their wind-blown timber. Without the market provided by the Government, it is safe to say that most of these owners would have had either to dispose of their timber for a fraction of its value or leave it to rot in the woods.

At the peak of the project, 241 sawmills under Government control, were engaged in converting logs into lumber. In selling log and lumber, first priority was given to sustaining local wood-using industries and otherwise meeting local needs. It is believed that more than 90 percent of the timber salvaged in this project went directly or indirectly into war use. Its availability at a time of urgent need, when shipping from other regions was crippled and rail facilities were overtaxed, more than justifies the cost to the Government of less than \$2 per thousand board feet.

As of June 30, 1943, receipts were \$14,166,460, as against expenditures, including all administrative costs, of \$15,223,674.

The project was financed by a loan from the Disaster Loan Corporation to the Federal Surplus Commodities Corporation. The latter created the Northeastern Timber Salvage Administration which was staffed by the Forest Service.

TROPICAL FOREST SURVEYS

The inadequacy of information about the forest resources of Central and South America has been emphasized by a growing number of special problems related to the war. To answer numerous requests for such information and to give tangible expression to the Good Neighbor policy, the Coordinator of Inter-American affairs transferred funds to the Forest Service to conduct surveys in tropical countries.

The first party went to Costa Rica in February and spent 4 months examining timber stands, testing promising species, and making recommendations on materials suitable and available in sufficient quantities for highway construction on six sections of the military road being built to connect completed portions of the Pan-American Highway. In one section the party examined and reported on a previously unknown forest of magnificent large oak many square miles in extent, containing trees up to 6 feet in diameter and 80 feet in clear length. Tests of specimens sent to the Forest Products Laboratory showed strength properties superior to our common white oak. In addition to facilitating work on the military road, the information obtained may lead to the establishment of new industry for the country.

This party also made some preliminary examination of woods useful for crating and shipping vegetables, and a preliminary aerial reconnaissance along the Atlantic coast to estimate the volume of balsa that might be available for utilization. It was also able to furnish advice on air and kiln drying of this wood and on reducing insect damage to balsa logs between time of cutting in the forest and sawing at the mills.

Another party spent 3 months in Ecuador examining the coastal forests with particular reference to timber suitable for shipbuilding. The party found that Ecuador has an ample supply of wood for shipbuilding. However, its mill capacity is not sufficient to support any substantial expansion in the production of ship timbers without interfering with the output of balsa of which Ecuador is the principal source. This party was also able to assist local manufacturers in the drying of balsa. In addition, specimens of local woods available in considerable quantities, having promise as substitutes for teak and

lignum vitae were shipped to the Forest Products Laboratory for testing and study.

A number of experienced Forest Service men were loaned to the Office of Economic Warfare to assist in procuring tropical forest products from Latin America. For example, two men were assigned to a survey of sources of quinine in Ecuador.

All activities of the Forest Service in Tropical America were unified last May under a Director of Tropical Forestry. This brought under one head the direction of the Tropical Forest Experiment Station, the Latin American Forest Resources Project, the administration of the Caribbean National Forest in Puerto Rico, and the cooperative work in forestry with the Puerto Rican insular government.

EMERGENCY RUBBER PROJECT

Guayule.—As reported last year, the United States undertook the development of native sources of natural rubber coincidentally with the construction of plants for the manufacture of synthetic rubber, after the Japanese invasion of the Dutch East Indies and shipping difficulties cut off the main supply. Expansion of plantations and other facilities for the production of guayule rubber was assigned to the Forest Service.

In the spring of 1942 nurseries were established in California for the planting of 21,000 pounds of guayule seed—all that was then available. In September 1942, when the rubber situation appeared increasingly critical, the President's Rubber Survey Committee endorsed the guayule project and recommended its expansion. Steps were immediately taken to lease the necessary land as rapidly as possible and to expand nursery capacity.

However, early in 1943, assertions that taking land for guayule might interfere with food production in California, coupled with a more favorable outlook for synthetic rubber, led the Rubber Director to recommend sharp curtailment of the guayule project. Accordingly, of 60,085 acres leased for planting but not entirely planted to guayule, 19,705 acres were restored to the owners and 1,616 acres were subleased to farmers for food production. Farm machinery and labor camps have also been made available to farmers when not required for guayule operations. Guayule plantings at the end of the fiscal year total 23,470 acres. The remaining 15,294 acres under lease will be planted to guayule or returned to farmers in the fall of 1943.

Additional plantings for experimental purposes, aggregating 831 acres, are located in all States of the southwest part of the country. Seven nurseries, aggregating 3,439 acres, are established in California, Arizona, New Mexico, and Texas. Sufficient stock is available in these nurseries for the expansion which the Rubber Director has again requested for the 1943-44 planting season. From mature cultivated shrub acquired in California in 1942, 440 tons of guayule rubber of high quality has been extracted.

Surveys of available wild guayule in Mexico and Texas have been completed. Operations to harvest wild shrub in Texas are under way. Surveys to determine areas of suitable climatic, soil, and water characteristics for guayule production are being made in

Texas, New Mexico, Arizona, California, and Mexico. Data are available to guide the initiation of any practical planting program in these areas. Planting stock and technical assistance have been given several South American countries and seed for experimental purposes has been supplied to a number of foreign countries.

Russian Dandelion and Goldenrod.—Stimulated by results of the 1942 test plantings of kok-saghyz (Russian dandelion)—the roots of this plant having yielded about 5 percent rubber—35 fields, aggregating 700 acres, extending from Oregon to Vermont, were sown in 1943 with Russian seed.

An experimental goldenrod program, involving 650 acres near Waynesboro and Savannah, Ga., was also undertaken. Contract covering land preparation and crop cultivation were arranged with owners of the better types of cotton land. The adaptation of standard equipment to plant goldenrod and to harvest and dry the leaf crop is an important phase of the current studies.

Cooperation With Other Bureaus.—The Bureau of Plant Industry, Soils, and Agricultural Engineering is cooperating in plant and soils research and the development of agricultural machinery for these three rubber crops. This bureau has also undertaken cooperative experimental plantings of guayule in Mexico. The Bureau of Agricultural and Industrial Chemistry is engaged in research related to the extraction of rubber from the three crops and the precompounding and vulcanizing of the product. It is planned to harvest part of the 1943 plantings of kok-saghyz and goldenrod in order to extract a few tons of rubber for testing purposes.

FISCAL

During the fiscal year 1943, expenditures by the Forest Service aggregated \$66,270,635. These moneys, derived from and accounted for under 77 separate appropriation titles, included:

Cooperation with States and private agencies in fire control, planting, and forest practice, \$5,664,202; contributions for fire control, slash disposal, improvement work, etc., \$1,935,520; liquidation of the Civilian Conservation Corps program on forest lands \$941,734; Emergency Rubber project, \$20,752,801; research \$2,412,869; expenditures for other Government agencies, \$8,615,358; general administrative expenses, \$586,133.

Expenditures for the national forests aggregated \$25,362,018, of which \$316,856 was for acquisition of land and \$5,023,046 for forest roads and trails. The balance, ~~\$2,022,116~~ \$20,022,116, was for operation and protection.

Net receipts from national forests during the fiscal year totaled \$10,056,393; of which amount \$2,502,543 was returned to the States in accordance with existing law.

REPORT OF THE CHIEF OF THE FOREST SERVICE, 1944

UNITED STATES DEPARTMENT OF AGRICULTURE,
Washington, D. C., September 22, 1944.

HON. CLAUDE R. WICKARD,
Secretary of Agriculture.

DEAR MR. SECRETARY: I consider it important that my annual report go further than a routine record of the many specific accomplishments of the Forest Service itself. A review of the forestry situation in the United States in its broadest relations to public forest policy seems indispensable because a vital part of our job is to cultivate a more adequate public understanding of the Nation's forest problem.

Conflicts of ideologies with respect to individual, State, or Federal interests and responsibilities inevitably make it difficult for people to view problems and cures objectively. Such conflicts have undoubtedly beclouded the issue during the past year. But in a democracy the interplay of diverse philosophies has compensating value. And I am confident that the underlying trend of public thought is in the right direction.

In reviewing the varied wartime activities of the Forest Service, the report emphasizes the potential contribution of productive forests to post-war prosperity. It calls attention to new developments in wood use and timber growing through which the annual growth of the forest crop may be made more nearly equal to national needs. It discusses the many ways in which forest restoration and development may be accelerated by post-war work programs. It warns against unwise attempts in post-war adjustment to colonize for agricultural use lands that are primarily suited for forestry. It restates my concern lest the trend of forest depletion and deterioration further impair the ability of the private forests to do their part in sustaining the level of industrial activity required for national security.

Each year the national forests play a larger part in the economy of the Nation because cumulative shortages of private timber place an increasing demand upon them. In the years ahead this demand may lead to local pressures to exceed sustained-yield cutting budgets. There must be no yielding to such pressures.

Tribute must be paid to the Seventy-eighth Congress, which in the face of circumstances that precluded consideration of a comprehensive forestry charter enacted three important features of such a program, namely: (1) increasing the authorization for Federal participation in cooperative forest fire protection; (2) authorizing the establishment of cooperative sustained-yield units for the integrated management of national forest or other public timber and intermingled or adjacent private timber; and (3) providing for completion of the forest survey and keeping it up-to-date.

Sincerely,

Lyle F. Watts

Chief.

FORESTS AND NATIONAL SECURITY

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FORESTS AND THE PEOPLE

SECURITY IS MAJOR OBJECTIVE IN FORESTRY

Under the impact of war, the public is more aware than ever that productive forests are a major element in national security. Forests protect watersheds that are vital for power development, irrigation, and flood control. The forest range makes large contributions to the supply of meat, hides, and wool. And wood is indispensable in the national economy, entering into thousands of uses and filling hundreds of critical needs. An abundant timber supply is a prime requisite of national security.

Productive forests also contribute very directly to the individual security of a substantial segment of the population. Productive forests mean thriving industries cutting and processing timber, fabricating wood products and converting wood into pulp, paper, and other chemical products. Productive forests mean jobs and pay rolls for hundreds of thousands of workers and opportunities for other thousands in professional, personal, and public services. It is generally recognized that individual security in the post-war world will depend in no small measure on the ability of the Nation to maintain reasonably full employment. Full employment implies a high level of national output. And productive forests constitute an important source of raw materials for the industrial activity necessary for such a national output.

Finally, both national and individual security are bound up in the health and well-being of the people. That the Nation falls far short of desirable standards in this respect is evidenced by the large

proportion of young men found physically unfit for military service. Although the public has not been fully aware of this problem, it is a matter of national concern demanding constructive post-war action. In its solution the forests have an important part to play.

Wholesome outdoor recreation, such as can be enjoyed in the forests, constitutes one factor in maintaining adequate standards of public health. The special facilities needed to enable large numbers of people to enjoy recreational opportunities in the forests can best be provided on public lands. Furthermore, the country may adopt a permanent program of forest work for youth. Experience with the Civilian Conservation Corps during the depression years showed how valuable vigorous outdoor work under adequate supervision could be in building a healthy citizenry and at the same time cultivating an understanding of basic problems of forest conservation.

FOREST WORK IN POST-WAR EMPLOYMENT PROGRAMS

In any event, forest work should have an important place in plans for post-war employment. A huge volume of forest development and restoration work needs to be done in the interest of national security and well-being. Millions of acres now practically idle need planting. Extensive areas of young growth need weeding, thinning, pruning, or other cultural work. Snags that constitute a fire menace over thousands of acres need to be cut down.

More lookout towers, fire breaks, truck and tractor trails, telephone lines, water holes, and other improvements are needed to provide adequate fire protection. Hundreds of miles of access roads need to be built to facilitate timber harvesting. Proper management of forest range resources calls for extensive range reseeding as well as for the construction of additional fencing and water facilities. Full utilization of forest recreational values will require the development of hundreds of camp sites, picnic spots, organization camps, bathing facilities, ski shelters, etc. Many structures will also be needed for better watershed management.

Such work is sound and necessary and well suited to the relief of unemployment. For the most part it requires little in the way of heavy equipment or skilled labor. Most of it can be undertaken at short notice—and the value of work accomplished is not lost when the program of employment is curtailed. Such work does not compete with private industry but does promote the public interest.

Thus, a program of public works to provide employment in case of need may become a major channel for expediting essential forest development and improvement. Preparation for a large employment program is a substantial undertaking that can be only partially handled as an incident to regular activities. Areas in need of planting must be surveyed. The method of planting, the species and kind of stock to be used must be determined for each tract. Nursery production schedules must be worked out so that the desired quantity of planting stock will be available when and where needed. Areas in need of weeding, thinning, other cultural work, or snag falling must be listed, and the work to be done needs to be defined for each stand. Arrangements must be made for housing of men and for transporting them to work. Equipment needs must be worked out in detail and a system of maintenance provided. Blueprints and specifications are

required in connection with the improvements and structures needed for protection, range management, and recreational development. Surveying routes for truck trails and access roads involves extensive field work, and much work must be done to design the bridges and other structures that may be required.

The Forest Service is fully alert to the urgency of preparing for post-war forest work, but has been able to assign only a small staff to detailed project planning. It has brought down to date its 6-year work program and is in a position to provide a large volume of work without delay. However, for maximum efficiency a large amount of detailed planning is still needed.

The work that needs to be done for forest restoration and improvement represents only one aspect of safeguarding the forest's contribution to national security. The magnitude of the job of replanting good timber lands that have been denuded, invaded by brush, or taken over by inferior growth, and of rendering huge snag fields, such as were created by the great Tillamook fires in Oregon, safe for timber growing makes it obvious that security for the forests is more than public works.

Closely related to this question of forest restoration is the problem of proper use of the land itself. In discussions of how to reabsorb returning soldiers and sailors into civilian life, plans are frequently proposed for opening up new lands to provide a large number of subsistence homesteads. Most of the land in forested regions that is both physically and economically suited for successful farming has long since been opened up. Another back-to-the-land movement involving clearing of forest land, such as followed the last war, would be regrettable. Almost certain disillusionment of the veterans and their families would be followed in many cases by the need for public expenditures for reforestation. This is not to say that opportunities for further development of sound rural communities based on correlated use of forest and agricultural land do not exist.

FOREST SERVICE CONTRIBUTIONS TO SECURITY

The need for lumber and other forest products in war has thrown new light on the unsatisfactory status of our timber resources. Realizing the importance of abundant and well-distributed timber supplies, there is a growing concern about the fact that annual growth of usable timber is far below national requirements. Accordingly, the Forest Service is giving more attention to post-war problems and needs as military demands upon it are terminated or curtailed. Nevertheless, war work inevitably continued to dominate most Forest Service activities during the past year. And the number of Forest Service employees on furlough for military service increased to 1,740.

ASSISTANCE TO PRIVATE OWNERS, COMMUNITIES, AND STATES

Because the bulk of our timber cut comes from private forest lands, the Forest Service has an important responsibility, as well as a large opportunity, to contribute to national security by striving to interest, guide, and assist private owners in better management practices on their own lands. During the past year, however, assistance to private owners and industries has been largely directed toward the

immediate problems of wartime production and utilization of lumber and other forest products. Even though production shortages in certain specialty items such as aircraft spruce no longer exist, and the major demand now is for boxes and crates for overseas shipments, lumber continues to be one of the most critical war materials.

Timber Production War Project Increases Output of Small Mills in East.—Early in 1943 it became apparent that the output of the 20,000 small sawmills that normally account for two-thirds of the lumber produced in the East was falling off rapidly. The increasing demand for crating, boxing, and dunnage lumber, that constitute a large part of the output of small mills operating in second-growth timber, made their output a major war-production problem. Accordingly, the War Production Board requested the assistance of the Forest Service in providing services to small logging and mill operators in the area east of the Great Plains for the purpose of stimulating production. Congress appropriated \$1,000,000 for the project and work got under way late in August 1943.

At the outset the project was limited to the stimulation of lumber and veneer-log output in 25 Eastern States. Subsequently the area was extended and the project was expanded to include pulpwood as a major objective and naval stores, excelsior, and veneer as minor objectives. All public and private agencies concerned with forests and forest industries are encouraged to participate in this project. Contributed services furnished by cooperating agencies, notably the State forestry departments and extension services, totaled over \$900,000 in value.

During the year the primary bottlenecks in the output of urgently needed forest products were inadequate labor, equipment, and stumpage. In the labor field, the project participated in handling about 6,500 cases of draft deferment for key workers in the forest industries. Deferments were obtained in 75 percent of these cases.

The project worked closely with the United States Employment Service in recruiting both men and women for woods and mill work and in stimulating the employment of farm labor during slack farming seasons. The problem of absenteeism was attacked by "caravans" which informed workers about the use of, and need for, wood products in the war. About 70,000 woods and millworkers and their families attended these caravan showings with decidedly beneficial results.

The project also undertook the training of 9,000 prisoners of war for woods and sawmill work. About 65 percent of these prisoners were employed in cutting pulpwood, 30 percent in lumber production, and 5 percent in other forest work. Most of the prisoners were employed in the Southeast, although some have been used in the Lake States and the Northeast.

Major difficulties have been caused by lack of adequate equipment and transportation facilities for logging and milling. Timber Production War Project personnel have assisted the War Production Board and the Office of Defense Transportation in investigating requests and submitting reports to facilitate the distribution of new trucks, tractors, and power units. Special attention has been given to working out a satisfactory procedure for the transfer of surplus trucks from the Army to operators needing such equipment in war work. Project personnel have been able to expedite the procurement of tires and gasoline. They encouraged the use of labor-saving equipment, such as power saws, and of more efficient operating methods.

Stumpage to keep mills operating was a problem in some localities. The Timber Production War Project has assisted in bringing buyers and sellers of stumpage and logs together. Much stumpage was being held off the market by public and private owners who, for a variety of reasons, did not wish to dispose of their trees. By furnishing information on markets, by appeals to patriotism, and by offering assistance in marking the trees to prevent destructive cutting, much "frozen" stumpage has been released for war use.

Varied other services were also provided, such as help in applications for aid in construction of access roads, in furnishing specifications for needed material, and giving information concerning Smaller War Plant Corporation facilities.

It is not possible to measure all the accomplishments of this project in terms of specific volumes of stimulated production. Perhaps a major benefit is the fact that it has placed well-informed men in the field to whom logging and milling operators could turn for advice on Government regulations and for assistance on other production problems. Field records indicate that the project has stimulated the production of about $1\frac{3}{4}$ billion board feet of all products. In view of the fact that this project is chiefly concerned with small mills, it is significant that for the first 6 months of 1944 the small mills cutting less than 1 million board feet a year increased their output 6.7 percent compared with the same period in 1943, whereas the output of mills cutting between 1 and 5 million board feet decreased 11.1 percent, and those cutting over 5 million board feet dropped almost 20.4 percent.

Texas Timber Salvage Program.—Closely akin to the Timber Production War Project is the Forest Service program to salvage for war use timber damaged by the severe ice storm in Texas and Louisiana on January 13 and 14, 1944. The storm swept over about 5,000,000 acres along the Sabine River. On about 310,000 acres, almost all loblolly pine type, the damage was so heavy that special salvage operations were feasible. The damaged material on this area was estimated at three-quarters of a million cords of pulpwood and 100 million board feet of saw timber. A large part of the heavy damage was on national-forest land.

Although pulpwood and sawmill operators immediately undertook to speed up logging in the stricken area, it was apparent that the volume of timber available for salvage was much more than could be handled with local manpower and equipment. Accordingly, the Forest Service, financed by a loan of up to \$3,000,000 from the Disaster Loan Corporation, was given the job of administering a salvage project as an agency of the Federal Surplus Commodities Corporation. Headquarters were opened at Lufkin, Tex. Using war prisoners as laborers, 6 work camps were established with combined facilities for 2,600 woods workers.

The Forest Service program is chiefly concerned with salvaging timber on national-forest lands. However, damaged timber is being purchased at fair prices from private owners unable to sell through normal commercial channels. All the timber salvaged is being worked into pulpwood or sawlogs and sold to nearby industries. Salvage operations are expected to be completed by the end of 1944.

New England Timber Salvage Program Completed.—On January 1, 1944, the Forest Service figuratively "sawed the last log" in the timber-salvage program launched in 1938 as a result of the disastrous New England hurricane. The Northeastern Timber Salvage Admin-

istration, administered by the Forest Service acting as agent for the Federal Surplus Commodities Corporation and financed by the Disaster Loan Corporation, undertook the job of aiding landowners to salvage the wind-thrown timber. The Forest Service established log grades and prices to prevent disorganization of the timber market, set up more than 800 receiving sites, purchased and stored logs, sawed or contracted for sawing them into lumber, and channeled the lumber into market outlets. At the close of the program more than 660,000,000 board feet of sawlogs and 35,000 cords of pulpwood had been purchased from 13,000 timber owners. It is safe to say that most of this timber, which proved to be so urgently needed when the war broke out, would never have been salvaged otherwise. Total cost of the program was \$16,269,300, of which almost \$15,000,000, or 92 percent, was recovered by the Government.

Technical Assistance in Private Forestry.—Preoccupation with war-production assignments has limited the time available to the Forest Service for private forestry cooperation. However, war activities have opened up new opportunities for improving the management of private forests. Through the Timber Production War Project, for example, many of the 20,000 small sawmills in the East that never before had been offered advice and assistance on forestry matters were reached. Such contacts provided a means to point out the saving of manpower and the increased output obtained from cutting, transporting, and milling large trees as contrasted to smaller, less-mature timber. Operation in stands marked for selective cutting demonstrated to sawmill men that good forest practice need not impair their profits. At the same time, such operation often demonstrated to owners reluctant to cut at all that timber harvesting need not destroy the aesthetic value of the forest. Wartime demand for forest products and increasing competition for available saw-timber stumpage have created in many localities far greater interest in better forest management than was prevalent before the war.

Farm Forestry.—Wartime demand for forest products has brought increasing pressure on farmers to sell their standing timber. Without forestry guidance this pressure generally results in the farm woodland being cut clear, with little regard to maturity and no thought of maintaining a growing stock as the basis for future crops.

To aid farmers in inventorying, harvesting, and marketing their timber, 89 farm-woodland marketing projects, involving 356 counties, have been established with a farm forester in charge of each project. Seventy-one of these projects are State directed and the balance Federally directed. In the fiscal year 1944, \$245,000 of Federal funds was available for this work. Funds are allocated to States on the basis of the amount of productive farm woodland within each State. Federal allotments must be supplemented by State or local expenditures or services.

Under the service given by the farm forester, the timber ready for removal is estimated and selectively marked for cutting so as to remove only the mature, crowded, crooked, or defective trees and leave a vigorous stand for future growth. The timber is appraised for sale and competitive bids are solicited. The farm forester assists in drafting a simple sale agreement which will protect buyer and seller. The program has often resulted in the farmer's receiving an increase of 50 percent or more over the lump-sum sale practice for his timber, while leaving the woodland in good growing condition.

A number of forest farming demonstration projects have also been set up in cooperation with farmers. In these a detailed forest management plan is prepared and complete records are kept of expenditures and receipts. Farmers find that they can obtain revenues from their woodlands which, in proportion to labor and capital required compare favorably with the return from agricultural cropland. Nine of the 10 intensive demonstration projects originally established were continued during the past year. Eight were State-administered and only 1 was supervised by the Forest Service.

A total of 300 million board feet of forest products were marketed or used on the farm in the fiscal year 1944 under the direction of the project foresters. In addition, almost 7,000 barrels of gum rosin and 21,000 gallons of maple syrup were harvested.

The Forest Service continues to cooperate closely with the Farm Security Administration, furnishing current information on new developments in farm forestry and giving assistance and advice on forestry practice in cases involving particularly knotty problems.

It also continues cooperative relationships with the Farm Credit Administration and the Federal land banks. A new policy has been developed by the land banks whereby loans will be made to farmers with security based primarily on farm woodlands, taking into consideration good-management practices that improve their productivity. The Forest Service has assisted in drafting instructions for the use of land bank appraisers in valuing farm woodland, and will also help to train these men in the woods.

Farm Forestry Extension.—Farm forestry extension is the responsibility of the Extension Service, but is carried on cooperatively with the Forest Service. During the last fiscal year 43 States and 2 Territories conducted State-wide farm-forestry extension programs, employing 50 extension foresters and assistants. Federal funds distributed to the States totaled \$78,234, which was offset by \$118,494 in cash. The effectiveness of the Federal appropriation was more than doubled.

The State extension foresters' efforts during the past year were aimed at facilitating the war program, particularly in stimulating production of farm forest products. Considerable attention was devoted to the protection of farm resources, such as crops, buildings, timber, etc., from fire. Some extension foresters assisted in directing and placing farm labor for agricultural production. Other activities included 4-H Club work, preservative treatment of fence posts, tree planting, and establishing shrub and tree windbreaks to conserve moisture for farm victory gardens.

Timber-production leaflets and circulars, prepared by State and Federal agencies, have been distributed in large quantities to farm people. Radio, news releases, and demonstrations have also been used to encourage farm-timber production. Special appeal letters from extension foresters and county agents have been particularly effective. Personal contacts have often been necessary to insure that the farm woodlands would be cut selectively and not destructively, and to assist in drawing up sales contracts, pooling products, labor and equipment, and marketing through cooperatives.

Naval Stores Conservation Program.—The Naval Stores Conservation Program, administered by the Forest Service for the Agricultural Adjustment Agency, is now in its ninth consecutive year. It reaches about 3,000 producers, involving about 85 percent of the pro-

duction. Much progress has been made in developing better methods of operation in accordance with approved forestry standards. In the face of a decline in rosin stocks from a total of 1,650,000 barrels to less than 1,000,000 barrels during the year ending April 1, everything possible is being done to stimulate production for war needs. This effort is complicated by labor and material shortages.

Community Forests.—Popular interest in community forests continues to grow, notwithstanding the fact that the war has greatly reduced the amount of planting and other development work. The Forest Service cooperates with local groups or agencies interested in or responsible for community forests. The establishment of new forests is being planned by many municipalities for the purpose of expanding recreational facilities and developing new timber resources after the war. Public schools are seeking school forests that may be used as outdoor laboratories. There is also a growing sentiment for community forests as living memorials to the war dead. Local plans invariably provide for the resumption of cultural work on the community forests as soon as the war is over. The development of such forests and utilization of their products will provide a reservoir of work to help offset possible unemployment after the war.

Cooperative Forest-Fire Control.—Cooperative assistance in the prevention and suppression of forest fires on nonfederally owned forests was continued in 42 States and Hawaii, and extended through these to many thousands of private forest owners. Wartime danger of disastrous conflagrations continued. Due to war pressure for increased output of forest products, cutting was generally heavy. Large accumulations of highly inflammable slash presented a constant fire menace in many States. Key leaders in fire control continued to enter the armed forces or take more remunerative jobs in war industries, thus further depleting the State protection forces. Very few local men were available for emergency fire calls.

In spite of these adverse factors, and the fact that nearly 3,000 more fires were reported on protected areas than last year, the record of 3,860,143 acres burned over and \$9,283,762 damage from 78,815 fires in 1943 was an improvement over 1942.

Congress again recognized the private forest land protection problem and appropriated \$6,300,000 for Federal aid in the prevention and control of forest fires on State, county, and privately owned land. Of this amount, \$4,000,000 was used to strengthen cooperative protection of the 290,928,000 acres previously protected and to start protection on an additional 8,403,000 acres. The remaining \$2,300,000 was earmarked by Congress for special protection on areas vital to national defense, without requiring an equal expenditure by State and private owners.

This \$2,300,000 was used largely for the employment of well-trained and well-equipped stand-by crews, strategically located so as to reach and extinguish fires promptly. Thus it served to prevent diversion of soldiers from training and of men from war industries and farm production to fire fighting; to mitigate loss and disruption in the output of forest products needed for war; to prevent destruction of military installations in forested areas; and to prevent smoky atmosphere which might interfere with military training and coastal defense.

The Forest Fire Fighters Service, which was created by the Office of Civilian Defense in July 1942, was continued and expanded. This

valuable Nation-wide volunteer service has attained a membership of about 185,000 rural citizens.

A third Nation-wide Wartime Forest Fire Prevention Program was planned by the War Advertising Council's Task Force in cooperation with the Office of War Information. It was endorsed by Secretary of War Stimson, Lt. Gen. Hugh A. Drum, and Lt. Gen. John L. DeWitt, as well as by the Secretary of Agriculture. It was again conducted with favorable results by the Forest Service and by the forestry departments of the various States.

Motion pictures continue to be available tool for fire-prevention and fire-control training. A fire-prevention film, *The Enemy Fire*, produced by the Office of Civilian Defense, and a fire-prevention trailer, *Your American Tragedy*, sponsored by the War Activities Committee of the motion-picture industry, were distributed in 1943. Another trailer, *American Saboteur*, was prepared for 1944 showing. A fire-training film based on conditions in the southern region is to be completed in 1944.

An outstanding event of the year was the enactment of an amendment to the Clarke-McNary law, increasing the cooperative fire protection authorization from \$2,500,000 to \$6,300,000 for the fiscal year 1945 and eventually to \$9,000,000, which represents one-half the amount estimated before the war as necessary to provide adequate protection to 430,000,000 acres of non-Federal forests. Under the law, the Federal contribution in any State cannot exceed the amount spent for forest fire protection by State and local agencies. Although expenditures in some States where intensive fire protection has been developed are far greater than Federal contributions, a number of States, particularly in the South, have been backward in providing for forest-fire protection. Some 131,000,000 acres are still without organized protection. Federal appropriations in line with the new authorization will make it clear that the Federal Government is ready to bear its share of providing for adequate protection. But the responsibility for bringing these 131,000,000 acres under protection and for strengthening the protective organizations in areas now inadequately organized lies primarily with the States.

NATIONAL FORESTS SERVE NATIONAL NEEDS

Wartime contributions of the national forests emphasize how indispensable these public properties are and how vital a part they play in national security and well-being. The record demonstrates the wisdom of intensive protection, effective administration, and far-sighted development. It foreshadows larger dividends in cash income, protection of watersheds, and opportunity for public enjoyment.

Fire Control on the National Forests, 1943.—In the forests of the western half of the United States unusually favorable weather prevailed throughout the normal fire season. However, fire danger became more acute in the fall, when the initial attack force was below full strength. Several late-season fires in southern California burned large acreages. In the South forest-fire danger was greater than normal throughout the year, and emergency forces were retained for longer periods than usual. Several fairly large and damaging fires occurred. In the Lake States and in the Northeast there were short periods of high danger but, generally speaking, the season was favorable and an excellent record was made.

The over-all record for the year was better than the average for the previous 5 years, viz:

	Calendar year 1943	5-year average (1939-43)
Total number of fires.....	11,829	13,700
Total number man-caused fires.....	7,314	7,535
Total area of national-forest land burned over.....acres	234,323	261,358

The year 1943 began with a shortage of experienced fire-control personnel. It was necessary to recruit large numbers of 16- and 17-year-old high-school boys, many elderly men, and some women. Thorough training of these raw recruits was essential. In some localities business and professional men and women were recruited and trained for part-time employment in the forest-fire-control organization. One such unit, the Portland Reserves, organized in the Pacific Northwest region, contained 149 members, who worked a total of 337 man-weeks. Its members manned 32 lookout stations and helped in the regional fire warehouse. The training program also included organized crews in many of the forest-using industries.

Selected groups of conscientious objectors in 15 Civilian Public Service camps, having about 1,800 assignees, were trained in fire-control work and were available when needed. Most of the 120 men used in 1944 as parachute "smokejumpers" to speed up attack on fires were drawn from Civilian Public Service camps throughout the country and assigned to a special training unit at Missoula, Mont. Parachute delivery of trained fire fighters in territory difficult of access by ground crews has proved effective and economical and has permitted some reduction in the ground force.

The armed forces deserve honorable mention in the forest-fire record of 1943. Special orders were issued by the War Department for cooperation with forest-fire-control agencies throughout the country. One result was a reduction in the number of fires in military-maneuver areas. But the most important contribution was made in actual forest-fire fighting—soldiers, marines, sailors, and coast guardsmen contributing approximately 50,000 man-days on the fire lines. Profoundly regretted is the loss of 10 soldiers and marines fighting fires in California. Prior to actual work on the fire lines, training in forest-fire-control techniques was given to 5,000 officers and men at 6 military bases.

The Army's far-flung Aircraft Warning Service system of 652 stations, operated by the Forest Service with War Department funds, was brought to a close at the end of the fiscal year.

Field investigations are being continued to determine the most effective and economical fire-protection organization for each national forest. Resourceful and bold thinking will be required to take full advantage of recent technological developments. A larger number of landing fields will permit much wider use of airplanes for forest administration and protection. Helicopters appear particularly adaptable to forest work. Landing spots will need to be located and surveyed for them. New equipment for radio communication, for transportation, and for fire fighting will doubtless require complete revision of all fire-control plans.

National-Forest Land Acquisition.—There has been no diminution of the need to acquire lands submarginal for private ownership and private lands so intermingled with or integrally related to the public lands as to influence the economy and efficiency of national-forest administration. Interruption of the purchase program is justified only as a war measure. During the year practically no new purchases were approved, but action on cases approved in earlier years brought into Federal ownership 102,074 acres at a cost of \$368,547. Acquisition of lands by grants in exchange for equal values of national-forest land or stumpage increased national-forest acreage by 335,152 acres.

National forest acreage was further affected during the year by numerous changes, including addition of 4,498 acres within the Minidoka National Forest, Idaho, by transfer from the southeast Idaho land-utilization project, and elimination of 3,090 acres from 3 national forests by transfers or public-land orders. In addition, 6,900 acres were excluded from the Huron National Forest, Mich., to permit addition to the Au Sable State Forest.

A beginning in the reorganization of national forest administrative units to conserve manpower and funds was made by the transfer of 160,359 acres from the Kaniksu National Forest to the Colville National Forest, and 241,952 acres from the Colville to the Chelan National Forest in the State of Washington, effective July 1, 1943. In Idaho, the Boise and Payette National Forests were consolidated into the Boise National Forest, with a gross area of 2,957,950 acres. The Weiser and Idaho National Forests were also consolidated and designated as the new Payette National Forest, with a gross area of 2,411,639 acres. Other changes now being studied will probably be consummated in the near future.

National-Forest Timber Supplying Increasing Proportion of Nation's Lumber Cut.—The cut of national-forest timber in the fiscal year 1944 was by far the highest on record. The $3\frac{1}{2}$ billion board feet cut under sales and exchanges exceeded the 1943 record by almost a billion board feet. National-forest timber supplied about 10 percent of all the lumber cut in the United States.

The value of all timber cut under sales and exchanges increased to an even greater degree than the volume, reaching \$14,300,000, or 64 percent more than the previous year. War needs called for many special items commanding unusually high prices, such as clear Douglas-fir logs for ship decking and pontoon stock, high-grade logs of Sitka spruce, noble fir, western hemlock, and tulip poplar for aircraft veneers and lumber, and white-oak timbers for shipbuilding purposes. These demands for timber of high quality raised the average value of national-forest timber cut from \$3.68 per M in 1943 to \$4.25 per M in 1944. Since the demand for specialty products has passed its peak, a decrease in the average value of timber cut on the national forests is anticipated for the next fiscal year. Major emphasis is now being placed on common lumber for shipping containers and logs for pulp mills.

The Alaska spruce log program, initiated as a war project in 1942, is being terminated because the requirements for aircraft lumber for military purposes are now reduced to the point where they can be supplied from Oregon and Washington. By the end of 1944, when the project should be completely liquidated, 38 million board feet of high-grade Sitka spruce logs will have been delivered to Puget Sound

mills. In addition, some 46 million board feet of hemlock and low-grade spruce logs will have been delivered to sawmills in Alaska for use of the armed forces there.

In the light of some indications that the market and raw-material supply situation after the war would justify permanent development of the pulp and paper industry in Alaska, the Forest Service invited inspection of a large tract of timber in the southern part of the Tongass National Forest and prepared a tentative draft of the conditions under which the timber might be offered for sale. The Forest Service will require that the timber be manufactured in Alaska in order to foster continuous employment and the building of permanent, well-planned industrial communities. Such a development will necessitate contracting for perhaps 5 billion cubic feet of timber to be cut in a 50-year period. The industry would have an almost year-round logging season, cheap log transport in protected channels between woods and mill and also water transportation for in-bound supplies and out-bound products.

The conduct of national-forest-timber sales has been closely coordinated with the programs of war agencies, such as the War Production Board and the Office of Price Administration. All possible efforts were exerted to avoid loss of production in established mills by reason of shortage in stumpage supply. Field officers of the Forest Service actively participated in the administration of the access-road program under the Defense Highway Act. This has been one of the chief Federal aids to enable the lumber industry to maintain wartime production schedules.

Despite shortages of qualified technical personnel, every effort has been made to maintain silvicultural standards of cutting. In a few instances cutting has been permitted in excess of sustained-yield capacity in order to avoid shut-downs of established mills. Such overcutting is justified only as an emergency measure and will be terminated as soon as wartime demands for lumber have passed.

Timber-stand improvement and slash-disposal work have been held to the minimum to conserve manpower. Funds have been accumulated under the authority of the Knutson-Vandenberg Act, which will enable the Forest Service to resume the improvement of timber stands by removal of worthless cull and weed trees from areas cut during the war period as soon as labor becomes available. Funds are being retained to complete cooperative slash-disposal work in accordance with established standards as soon as this can be done without interfering with log production.

Nurseries are being maintained on a basis that will permit rapid expansion to provide stock for the resumption of a planting program at the close of the war. The only tree planting which was possible in the last year was that done by Civilian Public Service labor (conscientious objectors), high school students, or volunteer groups, such as Boy Scouts. On the Siuslaw Forest, in Oregon, a Civilian Public Service Camp has completed the planting of some 10 square miles of land acquired in badly cut-over and burned condition. In the aggregate the amount of planting accomplished was insignificant in view of the fact that planting is the only means of returning about 2,200,000 acres of national-forest land to productivity.

Cooperation with the Bureau of Entomology and Plant Quarantine in the battle against the white pine blister rust and tree-destroying insects continues. The blister rust control program, particularly in

Idaho and California, received the major emphasis. Crews for the ribes eradication work were recruited primarily from high school students. A total of 471,871 acres was treated during 1943. Within the areas designated for control work 1,400,000 acres remain untreated.

A virulent bark beetle attack in the spruce forests of Colorado has resulted in a widespread loss of timber, especially on the White River National Forest. The extent and nature of this infestation is being studied and control measures will be inaugurated if feasible means can be designed. Salvage sales are under way. Continued control measures were necessary for the bark beetles, which are in epidemic stage in the Wasatch Mountains of Utah. Elsewhere systematic checks on the forest-insect situation were maintained in cooperation with the Bureau of Entomology and Plant Quarantine.

Cooperative Sustained-Yield Units Authorized.—The sensational increase in cutting of national-forest timber foreshadows pressure for heavy cutting in the post-war era, as depletion of nearby privately owned timber becomes more acute. A major step towards obtaining the maximum benefits from the national-forest system for support of timber-dependent communities was the enactment of Public Law 273, on March 29, 1944.

This law gives the Secretary of Agriculture and the Secretary of the Interior authority within their respective jurisdictions: (1) To establish cooperative sustained-yield units for the purpose of coordinated sustained-yield management of the public and interrelated private lands; (2) to enter into cooperative agreements with willing land-owners within such units, under which, in consideration of the assured privilege of purchasing Government timber and of other benefits from coordinated management, they will manage their land in strict accordance with requirements as to the rate, manner, and time of cutting prescribed by the Secretary; and (3) to establish sustained-yield units of Federal land where necessary in order to maintain dependent communities; and within such units to sell timber without competition at not less than appraised value to responsible purchasers established in such communities.

In the application of this law it will be necessary to proceed with great caution in order to make sure that long-time commitments of national-forest timber are made only where they are clearly in the public interest and, in the case of cooperative units, that the Government has chosen the most favorable cooperative tie-up available. Public hearings are required in connection with the establishment of each proposed unit and cooperative agreement.

In Federal units where community dependence has been clearly established, timber sold from the unit must be given at least primary processing in the dependent community. Existing plants, if reasonably efficient, will ordinarily be given preference in sale of national-forest timber. In some cases an operator may be required to modernize his mill in order to be in a position to convert the timber suitably or to add remanufacturing facilities in order to broaden the employment base, before being allowed to buy timber noncompetitively.

A statement of policy and procedure for the administration of the act on national forests has been issued.

Range Management on National Forests.—The situation with respect to range management on the national forests is just about what it was a year ago. Number of livestock grazed was almost the same,

but receipts from grazing again increased—by about 25 percent—bringing the total for the year to \$2,458,946.

Of outstanding significance has been continued success in avoiding such increased stocking as characterized handling of the range during the first World War. In addition, leaders in the livestock industry have urged producers to market animals before weight losses result from insufficient forage. High priority is being given to measures needed to bring the use of ranges that are still in bad shape in balance with grazing capacity.

A conference of regional foresters, range-management staff, and experiment-station men reconsidered established policies in anticipation of the close of the present 10-year term-permit period in 1945. An understanding was reached that no major change would be made in the present policy regarding distribution of the grazing privilege. It is planned to issue 10-year term permits again in 1946, where range conditions justify. Stockmen generally welcomed this announcement as a factor contributing to stability in the use of national-forest ranges. Opportunity was provided at the conference to discuss this and other policies to be applied during the new term period with representatives of the livestock industry.

Forest officers continue close cooperative relations with some 800 local livestock associations and advisory boards. These are media through which range conditions and Forest Service policies can be discussed with groups of permittees. Many valuable suggestions for improved management of the national-forest ranges originate in these boards and associations.

Some very encouraging progress has been reported in range reseeding, especially in Utah and Nevada. The work is to be continued there and expanded wherever reseeding appears to be a practicable means of correcting depletion and of increasing grazing capacity.

To date the Government has invested \$14,328,143 in national-forest range improvements, such as fencing, watering facilities, range reseeding, and rodent control. These, together with better care and better animal husbandry on the part of the users, are paying dividends, both in improved range conditions and in quality of livestock products. Much remains to be done before the full potential productivity of the forest ranges can be attained. Only when fully developed can the ranges contribute their utmost to the security and welfare of the Nation.

Wildlife an Important Feature of National-Forest Management.—One of the surprising developments of the war period has been the continued, and in some localities the increased, interest in the use of national forests for hunting, fishing, and wildlife study. During the past year, in addition to time spent by recreationists observing and photographing wildlife, hunters spent about 2 million and fishermen about 2.4 million man-days on the national forests.

It is not known how many fish were caught, but the take of big game was estimated to be 193,000 deer, 26,000 elk, and 5,700 black bear. These are believed to have yielded approximately 27 million pounds of usable meat. In addition, hides were made available for processing into soft-leather goods needed by the armed services.

Despite reduced personnel and a general curtailment of wildlife work, considerable progress was made in working out big-game management plans for national-forest areas in cooperation with the State game commissions and other interested agencies. These plans are

ordinarily built around deer or elk herds which can be handled as units because of topographic and other considerations. The cooperative effort includes a determination of the size of the herd, the extent and condition of the year-long range, and a program of control designed to keep the number of animals in balance with the available and long-time food supply. In this way the herds will yield an annual crop to hunters for an indefinite period, and thus materially contribute to recreational values of the national forests.

Some thought has been given to post-war plans for further integrating wildlife management with management of timber, forage, and water resources in a manner that will best promote the public welfare. Particular attention will be given to wildlife in heavily fished or hunted localities where intensive management is needed. Work will be done to keep such lands productive, and in some cases make them more suitable for wildlife. Some of the contemplated steps include fencing of key food and nesting areas for upland game, creation and maintenance of forest openings for grouse and turkey, protection of important big-game winter areas, and development of small lakes for fishing and recreation.

Where wildlife is of particular importance, timber harvesting, grazing, and other forest uses are adjusted to provide for the needs of wildlife. Strips along certain fishing streams are withheld from logging to protect the banks and keep the waters clear and cool. Already livestock have been excluded from about 4 million acres of national-forest range so as to benefit big game and other wildlife.

The national forests contain 1.5 million acres of fishing lakes and 100,000 miles of streams. They provide seasonal forage for 2 million deer and 165 thousand elk. They support a generous population of fur bearers and game birds. Perpetuation of these wildlife resources for the enjoyment of future generations is an important contribution to the security for which we strive.

National-Forest Recreation and Occupancy.—The national forests afford the public extensive opportunity for all forms of outdoor recreation, in winter as well as summer. Large increases in such use after the close of the war seem inevitable. During the calendar year 1943, despite the disruption caused by war, the public made over 6¼ million visits to some 4,250 camp and picnic areas, 200 swimming areas, 250 winter-sports areas, 55 organization camps, 11 hotels and resorts developed or controlled by the Forest Service, and other related national-forest areas. Curtailment, and in some instances complete discontinuance of the normal supervisory, protective, sanitary, and maintenance activities was a regrettable result of war demands upon the manpower and materials available to the Forest Service.

Since the advent of war, all national-forest lands needed by the War and Navy Departments have been promptly made available for their use by act of Congress, public-land order, secretarial letter of authorization, or Forest Service permit. During the past year 31 such areas, aggregating 845,000 acres, were made available. The total number of national-forest areas occupied by the armed forces at the close of the year was 127, embracing almost 3 million acres. Some additional areas were made available locally for temporary use.

During the year the demand for oil and gas leases on lands acquired under the Weeks law and related statutes greatly increased. At the end of the year 16 such leases were outstanding, involving about 14,000

acres. Revenues aggregated \$61,377. Other occupancy of national-forest lands for purposes of commerce, industry, recreation, and residence continued as in earlier years. The fees paid for special uses totaled \$535,045, which was \$61,974 more than in the previous year.

Renewed interest in national-forest lands suitable for homestead purposes is developing. Few areas adequate to support farm homes remain unappropriated. Of the more than 20,000 tracts listed for entry since 1906, virtually all of appreciable agricultural value have long since been patented. The listings of those which were abandoned after from 2 to 6 successive entries and those which, though subject to entry, were never entered, have been recalled because of this prima facie evidence that they actually possess no value for farm-crop production or are incapable of providing families with means of livelihood.

Engineering Staff Concentrates on War Work.—During the past year war work has continued to occupy most of the time of the engineering staff. The war-mapping project was terminated upon completion of precision topographic maps from aerial photographs for 2,750 square miles in Pennsylvania, Maryland, and Virginia. This job required more than 100 skilled surveyors and mappers. Twenty-one stereoscopic plotting machines, invented in the Forest Service, were used in turning out more than 100 quadrangles. Other confidential work on theater-of-war maps has been completed and additional work is being undertaken.

Specialists of the Forest Service photographic laboratory have devoted over 20,000 man-hours to aeronautical approach charts, foreign and domestic war mapping, and photostat and enlargement work for the Office of Scientific Research and Development.

The air-borne tractor and the snow cruiser developed in the Forest Service equipment laboratory at Portland, Oreg., are making enviable reputations with the Air Forces. The 40-inch-wide midget tractors, which can be readily run into a plane and transported to bulldoze out distant airfields, are in quantity production. The snow cruiser has hauled men and materials cross-country by trailer sled over deep soft snow and up 70-percent grades in Oregon, Colorado, Canada, and Alaska. In Labrador it demonstrated the value of hauling a dog team to the vicinity of a rescue, thereby saving time and strain on the dogs. Snow cruisers can also be used to extricate planes bogged down in snow.

Demands from the Army for Forest Service technical handbooks on roads, bridges, fire towers, signs, telephones, and water development have shown the value of the information compiled in these manuals.

Access roads to strategic timber and mineral lands have been the principal road-building objective in combination with the necessary maintenance on the 100,000 miles of development roads, the 150,000 miles of trails, and the 79 emergency-landing fields now serving the national forests.

RESEARCH LAYS FOUNDATION FOR SOUND PROGRESS

Forest Products Laboratory Works to Increase Utility and Value of Forest Products.—Ever since Pearl Harbor the facilities of the Forest Products Laboratory have been almost entirely directed to the solution of innumerable problems of wood use encountered by the Army, Navy, and War industries. The staff has been greatly enlarged

and some of the facilities are used on a three-shift basis to meet demands.

Many of the products and processes that are coming from the Laboratory's war studies will have immediate post-war industrial application. Others will require additional development effectively to meet commercial competition.

The wartime impetus to the technology of wood use broadens the channel through which the forest contributes to national security. More diversified and intensive utilization may increase employment in the wood-using industries without increasing the pressure upon the forest resource. New uses for wood and new processes for chemical conversion offer opportunities for reduction of waste and create markets for timber species and classes of material not previously saleable. Through better utilization, annual growth of the forest crop may more nearly meet national needs. Technological progress facilitates good forest practice by opening markets for material yielded by thinning and improvement cuttings, as well as for the cream of the crop. But there is always the danger that the same developments will lead to even more complete liquidation of forest growing stock by those who are not interested in continued productivity of the land.

The following accomplishments during the past year indicate the wide scope and diversity of the Laboratory's activities.

Work on the hydrolysis of wood and on the fermentation of the resulting wood sugars, done at the request of the War Production Board, served as a basis for the construction of a commercial plant near Eugene, Oreg., for the manufacture of industrial alcohol from sawmill waste. The pilot plant at Marquette, Mich., in which the original work was done, has been purchased and moved to the Forest Products Laboratory for further work on hydrolysis to increase yields and adapt the process to additional species.

Because of the potential significance of using wood waste as a source of alcohol, work has been started on processes for the utilization of lignin, an important component of wood not utilized in the making of alcohol. Commercial utilization of this byproduct promises to reduce the cost of alcohol produced from wood.

A new method of improving the physical characteristics of wood by chemical treatment known as acetylation was developed. The treated material resembles untreated wood. Weight is increased but specific gravity is only slightly affected. Tendency to shrink and swell is very much reduced. Indications are that acetylated wood will cost less than either "impreg" or "compreg" materials previously developed. Compreg is now being produced commercially by six companies.

Another form of compressed wood of high density and strength, called "staypak," was developed. Unlike compreg, staypak requires no resin for its manufacture. It has practically no tendency to lose its compression under swelling conditions. Its suitability for airplane propellers and other uses is now being determined.

The commercial use of papreg, the high-strength, resin-impregnated laminate developed at the Laboratory, expanded greatly during the year. It was produced by at least 4 companies. It was found to have many advantages over metal for certain aircraft uses. For example, papreg ammunition boxes effected a saving of 55 to 60 pounds in the weight of a combat plane and cost 25 percent less than metal boxes.

A papreg wing tip consists of only 13 parts compared with nearly 100 parts in an aluminum wing tip.

The work of solving the container and packaging problems for Army Ordnance equipment and supplies continued at a high level. Basic research was done on performance requirements and techniques of application for a number of newly developed packaging materials. Car-loading instructions were prepared for 13 kinds of military vehicles, and 459 instructions were prepared or revised for the export packaging of major items and spare parts, including the detailed procedures for cleaning, rust-proofing, and wrapping. Much emphasis was placed on the development of containers suitable for repeated use, to conserve the critical supply of lumber. This packaging work has resulted in a great saving in cargo space. It has been estimated that on an average 4 ships can now carry the material for which 5 ships were formerly required. A similar program is being carried on for the Army Air Forces. Work on the packaging of lend-lease foods for War Food Administration was expanded during the year.

A number of methods are being tried to improve the water resistance and strength of fiber boxes used for shipping war materials and food so that they may better withstand rough handling, especially under the severe conditions prevalent in the South Pacific. Work on wet-strengthened all-kraft fiberboards indicates that satisfactory boards for certain purposes may be made entirely from fiber reclaimed from old containers and mixed papers, thus saving the new pulp that now constitutes up to 60 percent of these containers.

At the request of the War Production Board, treating methods were developed that make Douglas-fir and noble fir suitable substitutes for Port Orford white-cedar battery separators, the supply of which is short. A hydrolyzed-wood-composition separator was also developed as a substitute for the hard-rubber separators now used in storage batteries that are shipped dry-charged.

Methods of improving the performance of small sawmills, of establishing saw speeds and feed rates which make most efficient use of the power available, and of constructing simple labor-saving devices were demonstrated to small-mill operators. Specifications for portable sawmills for combat units were revised at the request of the U. S. Engineer Board.

In response to many requests, an inexpensive kiln was designed to relieve the shortage of properly dried lumber, especially box lumber. The prototype kiln was built of wood and insulated with sawdust. The heating plant is a furnace equipped with a sawdust burner. Results of the first test runs were very promising. This development may prove to be permanently useful in connection with small or temporary sawmills or wood-working plants.

At the request of the Navy Bureau of Ships and the War Production Board, methods were developed for fabricating laminated ship timbers in order to reduce the demand for large timbers. A Manual on the Laminating of Timber Products with Low-Temperature Phenolic-Type Resin Glues was prepared on the basis of this work.

Much has been done to improve the use of wood in aircraft construction. A manual covering the structural repair of wood aircraft was prepared for joint publication by the Army Air Forces, Navy Bureau of Aeronautics, and the Air Council of the United Kingdom. The Handbook on the Design of Wood Aircraft Structures, prepared in 1942 for the Aeronautical Board, was revised to include design criteria

for wood airplanes and gliders established by recent research at the Laboratory. Dry-kiln certification studies to assure adequate facilities for drying aircraft lumber were made for the Army Air Forces. A number of rapid and reliable methods were developed for use by inspectors in determining the suitability of veneer and lumber for aircraft. A summary of information gathered on the durability of a wide variety of aircraft glues was prepared. Five staff members flew to England as guests of the British Ministry of Aircraft Production to obtain information on the use of wood and modified wood products in aircraft under war-service conditions, and to effect a more complete and continuous exchange of aircraft-research data.

During the year 6,525 persons, including officers and enlisted men of the armed forces and manufacturers' representatives, were given training at the Laboratory at the request of the Army, Navy, and the War Production Board; 5,940 of these were trained in the field of packaging and the remainder in the use of wood in aircraft, ships, and vehicles. Since the inception of these instructional courses about 2 years ago, 10,240 persons have received training.

Surveys of Requirements, Production, and Supplies of Forest Products.—The Forest Service continued working under agreement with the War Production Board on problems dealing with the supply, production, and consumption of forest products in the war program. Cooperation in this field was also extended to the Office of Price Administration and other war agencies. During the year lumber, pulpwood, and various other wood products became the most critical of our raw materials. This intensified the need of the several war agencies for more adequate statistics on requirements and supplies and for technical information concerning production and distribution.

Surveys conducted during the year included the following: A canvass of sawmills in cooperation with the Bureau of the Census to determine 1943 national lumber production, monthly surveys of current production and shipments of aircraft and other specialty-product lumber, quarterly surveys of lumber stocks on hand at sawmills and concentration yards, a survey of lumber stocks at retail and wholesale yards, monthly reports on hickory tool-handle production, and detailed monthly reports on shipments of birch and maple aircraft veneer.

Assistance was furnished the War Production Board in analyzing and forecasting requirements for lumber and other forest products. Nonmilitary claimant agencies were aided in estimating and reporting their needs.

A report was prepared covering the anticipated production and consumption of primary forest products for the current year and for 1945. This report included recommendations for increasing production and otherwise balancing the current supply and demand. Analyses of factors affecting lumber production for the various timber producing regions were furnished quarterly to the War Production Board and other war agencies.

Special attention was given to the need for equipment, tires, and repair parts by the lumber industry and the most feasible methods of transporting logs and lumber. Estimates were made of volumes transported, total tonnage, ton-miles, and average length of haul for sawlogs, lumber, and other forest products during the years 1941 through 1944. Special investigations were made of food requirements for loggers. The need for additional lumber dry kilns in the Northeast

was studied. Reports from veneer and plywood manufacturers were analyzed to determine the need for labor, equipment, and price adjustments to maintain or increase production.

Grading rules for aircraft lumber were prepared and production costs for those grades determined. Assistance was given in establishing log and lumber grades and specifications relative to area price controls. The effect of price controls on lumber production was also investigated.

The shortage of manpower for repetitive industrial surveys led to the development of sampling procedures that give reliable results at a fraction of the cost of 100-percent canvasses. The short-cuts now being used for emergency-production surveys will have permanent utility.

Forest-Resource Investigations Provide Essential Economic Information.—Wartime pressure for increased output of forest products, shortages of critical items and widespread timber depletion have emphasized the need for information on the extent and condition of forest land, the quantity, character, and location of timber, its rate of growth and depletion, and trends in requirements for forest products. In a large measure such information has been provided through the Forest Survey, authorization for which was recently amplified by enactment of Public Law 321. This law increases the original authorization for the forest survey to a maximum of \$750,000 annually, and authorizes an additional appropriation of \$250,000 annually to keep the survey current. The total cost of the initial survey is limited to \$6,500,000, of which almost \$3,000,000 has already been expended.

To date, one-half of the 630 million acres of forest land in the United States has been initially inventoried. More than three-fourths of the planned reports covering these areas have been completed. Two hundred and twenty-one reports on timber stands and forest-type maps for all or parts of 16 States have been issued. During the year, reports for 7 counties, 1 survey unit, and 1 State were prepared. For much of the area surveyed, these reports reveal that the forest situation is far from satisfactory.

For the past 3 years demands for specialized survey information for war purposes have precluded much progress on unfinished reports for five States in the South and Lake States regions. Field work to extend the area covered by the survey has had to be postponed. The many uses made of survey data for the half of the country for which field work is complete amply demonstrate the value of this project. Completing, improving, and maintaining comprehensive survey data will greatly aid in formulating sound policies and plans for the guidance of forest industries and of public-land administrators.

The annual study of stumpage and log prices, while continuing to fill its peacetime purposes, has been expanded to increase its value to war agencies concerned with price control and production.

Production costs for logs, mine timber, pulpwood, and fuel wood were analyzed in several critical areas for the Office of Price Administration and other agencies.

Following amendment of the Revenue Act to permit the taxation of gains attributable to stumpage at the capital-gains rate, the Forest Service used its influence to expedite the release of stumpage being held to avoid taxation at the rates applicable to earned income. After analysis of the new law, especially as it affects the smaller producer,

appropriate information on tax liability was disseminated through extension foresters and others.

Three field projects of especial importance have been continued. Analysis of operations of the farm forest cooperative association at Cooperstown, N. Y., a pilot plant sponsored by the Forest Service, resulted in marked modification and economy of mill and logging operations. In spite of operating handicaps and logging difficulties, the association's mill turned out 2 million board feet of lumber last year. The timber was cut from co-op members' woodlots under forestry methods adapted to the farm economy by this project.

Studies dealing with the potential contribution of the forest to the welfare of the anthracite region of Pennsylvania have yielded maps showing the location, size, and approximate volume of each timber unit in 15 counties. This information has greatly aided sawmill operators and mine-timber producers in locating suitable timber supplies. It has also aided local agencies in planning more efficient fire protection. In one section the number of fires has been reduced 75 percent as a result of a new local approach stimulated by these studies.

A progress report on work at the experimental forest at Crossett, Ark., shows how the cut per acre affects cost of felling, bucking, skidding, loading, and trucking in second-growth shortleaf-loblolly pine forests, and how tree sizes and selective logging affect realization value. There remains further investigation of the comparative economic advantages and silvicultural results of cutting cycles of different lengths and of alternative management and utilization practices.

During the year investigations were inaugurated dealing with economic aspects of fire control on sample areas in the Douglas-fir region of the Pacific Northwest and in the pine-hardwood forests of Virginia. These studies aim to establish a better basis for determining fire losses and costs of adequate protection. Who suffers the damage—whether landowner, worker, community or public—and the amount of fire damage under varying levels of expenditure for fire protection are important criteria that need to be thoroughly understood.

Forests and Stream Flow.—Forest-influences research has been reduced to a bare maintenance basis for the duration of the war. In fact, were it not for the contribution of a Civilian Public Service camp operated by the American Friends Service Committee it would not have been possible to maintain the extensive installations on the San Dimas Experimental Forest in southern California. Watershed management, guided by forest-influences research, should take a large place in post-war forest-development plans.

Forest-Management Research Helps Increase Forest Growth.—As a basis for better forest practices to increase the production of our forests, the store of sound technical information on all phases of timber growing and management must be enlarged. During the past year the cumulative results of some phases of forest management research have been brought together to make them of most use to those engaged in the handling of forest lands.

Perhaps the most significant of such recent publications is *Reproductive Habits of Douglas-Fir*, which tells in detail how cutting must be done in order to reproduce Douglas-fir under various forest conditions. Desirable practice must recognize that Douglas-fir reproduction will not become established under more than 50-percent crown canopy and that satisfactory restocking cannot be expected more than one-

fourth mile from an appropriate source of seed. In the Central Rocky Mountains recommendations based on more general observations have been compiled to guide wartime cuttings in the spruce-fir forests.

Anticipating that forest planting will have a large place in post-war programs, two comprehensive reports summarizing 20 years of research and experience in forest nursery practice and tree planting in the Lake States are nearing completion. Similar manuals are being prepared for the Central States and for the South.

Results of thinning, weeding, and other stand-improvement work by the Civilian Conservation Corps are being studied as a guide to future cultural operations.

The older experimental forests are becoming increasingly valuable as demonstrations and sources of tested information on desirable management practices. For example, on a 20-acre block of northern hardwoods in the Upper Peninsula Experimental Forest in Michigan, cuttings in 1926 and 1943 have yielded 75,000 board feet of logs and 350 cords of chemical wood. Yet the stand has nearly as much volume as when first cut and is more thrifty than ever.

The effect of methods of cutting and cultural practices on growth rate is being clarified by studies in many forest types, of which the following recent findings are illustrative. After 10 years, releasing of suppressed loblolly pine by girdling of worthless hardwoods was found to have yielded $1\frac{1}{4}$ additional cords of growth per acre for each man-hour of labor expended. Thinnings in 35-year-old jack pine in northwestern Wisconsin, yielding 6 to 9 cords per acre, netted the farmer 87 cents per hour for his labor in midwinter.

Partial cuttings were found to be practical in black spruce swamps of the Lake States, provided not more than 30 percent of the merchantable volume in trees over 6 inches in diameter is cut.

Because moisture rather than light is the limiting factor for growth of ponderosa pine in Arizona, adequate growing space rather than large crowns is necessary to maintain satisfactory growth. Analysis of stands in which careful records have been kept for 30 years following cutting, shows that an increase of net growth that occurred in the first decade was not maintained in the second and fell sharply during the third. Evidently 30-year cutting cycles are too long for best growth in the Southwest.

Work done to meet needs of military camouflage planting has yielded results of lasting value. For example, a heavy dosage of fertilizer applied to loblolly pine nursery stock during late fall or early spring prior to outplanting increased survival during a drought year as much as 20 percent. Thus an outlay of 30 cents per acre may forestall a loss of \$3 per acre in planting costs. By chemical treatment the spring dormancy of hardwood nursery stock was prolonged from 1 to 4 weeks. In this way, a normal planting season of 3 to 5 weeks' duration may be extended 25 to 80 percent.

Successful methods have been developed for planting red spruce and red pine on devastated lands heretofore considered unplantable in the Appalachians. Success depends in part on skillful application and timing of a release cutting to remove vegetative competition. Somewhat similar findings for planting of cottonwoods on bottom lands of the South were published during this year.

A number of test plantings of cork oak have been established in California, the Southwest, and the South, in cooperation with the

University of California and one of the large cork companies. Tree-breeding work has been maintained on a greatly reduced basis.

In naval stores research further progress has been made in increasing gum yields and reducing labor requirements by chemical treatment.

Good progress was made in developing cheaper and more effective methods for prescribed burning in the South to reduce danger from uncontrolled fires, facilitate fire suppression, clear the seedbed for reproduction, and improve forage for cattle.

Research-developed methods of measuring forest-fire danger in the East have been widely adopted by Federal, State, and private agencies. Constant technical supervision is necessary to keep them working effectively. The Appalachian station trained 90 observers in 18 States in connection with the operation of 290 fire-danger stations. In California the fire-danger rating system was completely revised, and a uniform system was adopted for determining needed manpower for different levels of fire danger. Analyses of fire records in Virginia showed that 80 percent of all fires and 97 percent of the suppression work came on class 3 and class 4 fire-days, which comprise about one-third of the entire fire season. One-tenth of the seasonal suppression job came on a single peak day in April. This emphasizes the need for organization to meet such peak demands.

Growing interest in commercial development of Alaska's forests calls attention to the need for a program of research in the Territory to provide a sound foundation for the utilization and management of Alaskan forest resources. Mistakes made in the pioneer exploitation of the forests of the United States must not be repeated in Alaska.

Range Research Promotes Greater Production of Forage and Livestock Products.—Range research promotes greater production of meat and other animal products by pointing the way to increasing the quantity of the better forage plants, by developing better use of the range, and by indicating more adequate coordination of forest range and other agricultural production.

In the South preliminary studies in cooperation with the Louisiana State Agricultural Experiment Station revealed that adequate forage and feed can be assured throughout the year by grazing forest range chiefly in spring and summer and coordinating this use with grazing on improved pastures and with supplemental feeding during fall and winter. In contrast to yearlong forest grazing, these practices give better calf crops, heavier weights at weaning, and lower death rates. More intensive studies by the Forest Service, Bureau of Animal Industry, and the Coastal Plain Experiment Station in southern Georgia show a wide difference in seasonal palatability and nutritive value among the various forest range plants. A few of the native plants are palatable and nutritious from spring to early fall, but most are deficient in calcium, phosphorus, and crude protein during the winter months.

At a time like this, when there is a need for every bit of forage which can be grown, the results of reseeding research on western ranges take on larger significance. In eastern Oregon, for example, where summer ranges produce only two-thirds of the forage needed to balance that available on spring-fall ranges, highly successful methods of reseeding mountain summer ranges have been worked out in cooperation with the Oregon Agricultural Experiment Station. Broadcast seeding in the ashes the first fall following fire in lodgepole

pine gave good stands of valuable forage at a cost of \$0.80 to \$2.65 per acre. On range lands where a disk grain drill can be used for seeding, this method has proven successful at costs of from \$1.75 to \$3.50 per acre.

The procedures to follow in regrassing southern Idaho range lands were brought together and published in cooperation with the University of Idaho.

Yearling heifers, grazed on short-grass-plains range of Colorado under heavy, moderate, and light stocking 4 summer seasons, from May to November, gained on the average 239, 274, and 293 pounds, respectively. Under moderate and light grazing, ranges were maintained or improved, while under heavy grazing considerable damage was done to the range in decreased growth of palatable grasses, thinning of the grass cover, lessening of seed production, more rapid run-off, and greater exposure of the soil to erosion. This impairment of the forage cover materially increases the hazard of drought and the cost of livestock production.

Control of undesirable plants is a problem of great importance to stockmen on practically all ranges. In the Southwest, for example, invasion of mesquite on grasslands reduces the grazing capacity, makes handling of livestock difficult, and increases loss of livestock from screw worms. Practical methods of eradicating mesquite consist of hand grubbing, the use of power equipment or treatment of the shrubs with a sodium arsenite solution. Costs may range from a few cents per acre where the shrubs are small and scattered to \$3 or over on more heavily infested areas.

In the Intermountain region it was found that by grazing wild-hay meadows until late spring, instead of stopping in early spring as in prevailing practice, the amount and quality of forage used by the grazing animals and harvested as hay was increased appreciably. The hay cut also contained 20 percent more protein.

On the chaparral-type ranges of Arizona, goats and cattle are often grazed together. Under such a scheme, ranges tend to deteriorate and erode unless very carefully managed. If production of the important perennial grass cover is to be maintained, the browse plants must be lightly used. If goats are grazed exclusively, browse can be used more heavily without undue damage to the grasses.

EMERGENCY RUBBER PROJECT

Guayule.—In the spring of 1943 guayule plantings were curtailed in accordance with the suggestion of Rubber Director W. M. Jeffers. In the summer of 1943, Rubber Director Bradley Dewey suggested that it would be sound insurance to enlarge the guayule program to produce 20,000 tons of rubber per year. A request for funds for such a program was denied by the House, approved by the Senate, and finally lost in conference. In the appropriation bill for 1945, the House called for complete liquidation of the project. Following a field investigation, a special subcommittee of the House Committee on Agriculture then urged continuation of the project before the finance subcommittee of the Senate and on the floor of the House. The House finally receded and agreed with the Senate to provide funds for maintenance of present field operations and research and for a higher rate of factory-rubber production.

Except for experimental areas, guayule plantations have been confined to California. The plantations aggregate 31,356 acres, of which 22,240 acres are irrigated. Curtailment of planting operations left the project with a surplus of seedlings in nurseries. Approximately 30,000,000 have been sold to guayule operators in Mexico. No other buyers could be found. The remaining seedlings are to be harvested and milled when of suitable size and rubber content.

Harvesting and milling of the remnants of a native stand of guayule in Texas were completed during the year. Although the wild shrub had been picked over twice previously in the past 30 years, and had been subject to grazing, enough plants were harvested to provide 227 long tons of rubber. This brings the total of rubber produced on the guayule project to 620 long tons. Experimental harvesting and milling of the plantings started in 1942 has begun. Production will be on a commercial basis at the beginning of the 1944 harvest season.

About 350,000 pounds of guayule seed was obtained from the season's harvest.

Extensive surveys, to determine areas of climatic, soil, and water characteristics suitable for guayule planting, have been completed. Research on soils and shrub growing and on extraction techniques has been carried on vigorously by the bureaus of the Agricultural Research Administration. A new mill now in the final designing stage includes advanced features developed through research.

While proceeding with release and disposal of surpluses, the guayule project continued the leasing of its labor camps, facilities, and equipment to farmers and public agencies when not needed for guayule production.

Kok-saghyz.—About 600 acres of kok-saghyz, experimentally planted in Northern States, were carried through the fall of 1943. Sufficient acreage was harvested to give information on yields under various climatic and soil conditions. While the yield of roots ran as high as 7,900 pounds of green weight per acre for the fall harvest, the average was between 4,000 and 5,000 pounds. Rubber content, which averaged about 4½ percent of dry weight from roots dug in the fall, was almost doubled in the roots dug the next May at approximately 11 months of age. Yields per acre in roots, rubber, and seed exceeded those reported by the U. S. S. R.

Congress did not authorize carrying this experimental program beyond June 30, 1944, but arrangements have been made for adequate tests of large truck and passenger-car tires manufactured from kok-saghyz rubber.

Goldenrod.—About 500 acres of goldenrod, mostly in Georgia, were carried until the fall harvest. Efforts of the project were concentrated on designing adequate harvesting, deleafing, and drying equipment. Due to the unexpected wide branching and profuse blooming habit of goldenrod when planted in widely spaced rows on good soil with frequent cultivation, the previously conceived and constructed harvesting equipment failed to separate completely the rubber-bearing leaves from the larger volume of non-rubber-bearing stem and bloom.

From the 500 or 600 pounds of goldenrod rubber recovered by the pilot plant, bicycle tires, hot-water bottles, and other articles have been fabricated.

This program was also terminated June 30, 1944.

FORESTRY MISSION TO CHILE

At the request of the Department of State, and financed by it, the Forest Service assigned five men to a forestry mission to Chile. This project, undertaken for the Corporacion de Fomento de la Produccion an agency of the Chilean Government, had as its objective an appraisal of the forest resource in Chile as a basis for the expansion of forest industries. This is part of a broad program by the Chilean Government to industrialize the country insofar as natural resources permit.

The mission spent 6 months in a rapid appraisal of the forest situation, including studies of timber volume, distribution and economic availability, forest depletion, forest growth, and national timber requirements both present and future. High lights of the forest situation are: (1) Chile has a substantial forest area: on a per capita basis her commercial forest acreage is comparable with that of the United States. (2) There is no forest practice worthy of the name in Chile's natural forest area, even organized fire protection being entirely lacking. In contrast, the small but substantial plantation area in Chile is very intensively managed, stand improvement operations beginning in some types at as early as 4 years of age, with harvest cuttings frequently at 12 to 15 years of age. (3) Under crude forestry, primarily fire protection, the forest resource of Chile could sustain permanently two to three times the industry now based upon it.

FISCAL

During the fiscal year 1944, expenditures by the Forest Service aggregated \$59,866,675. These moneys, derived from and accounted for under 120 separate appropriation titles, included:

Cooperation with States and private agencies in fire control, planting, and forest practice, \$6,735,408; contributions from outside sources for fire control, slash disposal, improvement work, etc., \$2,026,612; Emergency Rubber project, \$8,987,425; research \$2,132,725; expenditures for other Government agencies under Act of June 30, 1932, \$9,124,138; general administrative expenses, \$633,503. The expenditures for other Government agencies pertained to such projects as timber production (WPB), \$943,679; aircraft-warning service, \$2,054,503; access roads, \$2,856,957; war mapping, \$399,001; shipping containers (Army Ordnance), \$800,118.

Expenditures from appropriations for the national forests aggregated \$25,340,429, of which \$5,391,379 was for forest roads and trails, and \$98,194 for acquisition of land. The balance, \$19,850,856, was for operation and protection.

In addition, the Forest Service made expenditures for special projects as follows: The Northeastern Timber Salvage Administration, \$207,503; the Texas timber-salvage program, \$123,998; the Alaska spruce-log program, \$2,414,487; and the naval stores conservation program, \$947,692. The funds for these expenditures were made available to the Forest Service by the Agricultural Adjustment Agency, the Commodity Credit Corporation, the Disaster Loan Corporation, and other Government agencies.

Net receipts from national forests during the fiscal year totaled \$15,616,940, of which \$3,933,092 was returned to the States in accordance with existing laws.

FORESTS AND NATIONAL SECURITY AFTER THE WAR

FOREST OUTLOOK GIVES CAUSE FOR CONCERN

A detailed report of the activities of the Forest Service must be viewed against a background of the national situation and outlook with respect to forest resources.

The fears that have been expressed in previous annual reports as to the adequacy of our timber supply are proving to be well-grounded. Evidence continues to come in that forest depletion is rapidly becoming more acute. For example, in the summer of 1943, in the face of wartime pressure to continue operation, another long-established mill in Michigan closed for lack of timber. Similarly, during the summer of 1944 still another large sawmill in Wisconsin cut its last log and boarded up its windows and doors. In the highly productive Champlain and Hudson Valley sections of New York hardly any white pine timber of sawlog size remains uncut. Such a situation had previously been reported for much of the white pine region in Massachusetts and southern New Hampshire.

Furthermore, wholesale liquidation of the young timber which should be the source of sawlogs for decades to come continues to be a disturbing factor. It is most acute in the Northeast, the South, and the Lake States. It has even become a source of concern in California and the Pacific Northwest, for in these regions recent analyses emphasize how rapidly exhaustion of the virgin timber supplies is making itself felt.

In California, 7 percent of the sawmill capacity goes out of business or is forced to move to new locations each year because of lack of timber. A few months ago it was reported that the entire town of Westwood, Calif., with a population of 5 or 6 thousand people, was being offered for sale. This town depends upon a huge sawmill with timber in sight for only a few more years of operation. New opportunities for large-scale lumbering are becoming increasingly scarce. And annual saw-timber growth in California forests is only a fifth of the amount cut each year. It does not offset more than a tenth of the lumber consumed in the State.

In the Puget Sound district of western Washington, 165 sawmills, representing 41 percent of the total plant capacity, do not have sufficient private timber in sight to operate more than 5 years. Of course, public timber will help prolong the life of some of these mills, but drastic retrenchment in lumber output is inevitable.

In the Wenatchee and Chelan district the capacity of existing sawmills is twice the sustained-yield cut from public and private forest lands together. Yet annual growth there of ponderosa pine is only half enough to make boxes for the apples grown within the district.

So long as annual growth remains so generally below present forest drain, security in relation to our forest resources will not be achieved. Action is needed.

SOLUTION LIES IN COMPREHENSIVE FOREST PROGRAM

The course of forest exploitation in this country leaves little room for doubt that the public must act in a far more comprehensive manner than heretofore to stop destructive cutting, to facilitate good practices

on private forest lands and to acquire such lands as may not otherwise be given the management dictated by the public interest. These three lines of action are equally important. To neglect any one of them is to undermine the whole structure of security in respect to forest resources.

Public Cooperation.—It is in keeping with the tradition of our American democracy to encourage private enterprise in every legitimate way to provide the production, the employment, and the security upon which the welfare of the people depend. Earlier sections of this report outline the many channels through which the Government is attempting to aid and encourage good forest management by private owners. Such efforts to establish forest conditions for permanence and stability in the dependent industries and to protect other values inherent in forest lands need to be strengthened and broadened. They will continue to occupy a large part of the attention of the Forest Service.

Public Acquisition.—Public acquisition is advocated primarily for lands unsuited for private ownership, whether because of inaccessibility, inherently low productivity or need for reforestation. Public ownership is also needed to insure proper management for certain lands where watershed or recreational values predominate. Finally, it is important that the Government own certain tracts of good timberland that vitally influence timber management on adjacent national-forest lands or affect the welfare of dependent communities.

Although necessarily restricted in wartime, extension of the acreage of forest land in public ownership should be carried forward systematically and expeditiously after the war. Such a program of acquisition will remove uncertainties affecting forest-management problems in many localities, will simplify forest rehabilitation, and will clarify the social and community adjustments involved. But it constitutes only part of the forest program necessary for security.

Public Regulation.—Private-forest lands will continue to constitute the area from which the bulk of the raw material for our forest industries must come. Since the productivity of these lands is so vital to national security, their management cannot be left to chance. The public interest in them can only be safeguarded if measures for public cooperation and aid are backed by appropriate regulation of cutting and related forest practices. To assure adequate timber supplies for the future, young timber needs protection from destructive cutting as well as from fire. And cutting in mature timber must be done with an eye to reproduction. We have more idle forest land now than we can hope to replant in a generation.

One important lesson that should be learned from the war is that individual security is largely without foundation in the absence of national security. Since this is so, it follows that security, whether individual or collective, demands that the public interest take precedence over individual interests. This is especially important with respect to forests, for here the public interest clearly requires attention to forest practices so as to keep the land reasonably productive. Forest capital or growing stock must be conserved, or replaced if dissipated, whether or not the individual landowner has any interest in the continuity of his forest enterprise.

During the past year there has been considerable further discussion of the suggestions for public regulation that have been made in every annual report of the Forest Service since 1937. Opposition has

come largely from sources concerned either with maintaining a maximum area of freedom from Government interference or with forestalling what is interpreted as Federal encroachment on States' rights.

The forest products industries have continued a campaign of publicity tending to mislead the people on the seriousness of the forest situation. One syndicated editorial that appeared in June went so far as to assure the public that "the Nation's lumber supply problem has been solved," on the authority of a statement from a commercial company. The Forest Service has been charged with a lust for bureaucratic power. Regulation of forest practices has been misrepresented as a move to nationalize the forest industries. Such studied effort to reassure the public as to timber supply and such emotional reaction to proposals to protect the public interest are, I believe, strong indications that public sentiment for regulation is spreading. The implication is that this trend in public thinking is feared by those whose purposes or philosophy are in conflict.

The Forest Service proposals, it should be emphasized, allow ample latitude for the States to work out their own problems of forest regulation, and considerable attention has been given to regulatory legislation by the States. Although their legislation is not fully adequate, Maryland and Massachusetts have moved toward the formulation of rules of forest practice under laws enacted early in 1943, and Mississippi has been added to the list of States enacting laws dealing with the subject.

The forestry committee of the Council of State Governments has been actively studying the problem of State forest regulation. But these State efforts do not eliminate the need for Federal action. Basic standards of forest practice should be defined in Federal legislation. To assure reasonably prompt and uniform Nation-wide application, the Federal Government should have authority to undertake regulation in any State that fails within a specified number of years to enact and enforce regulation conforming to Federal standards.

PROGRESS BY SOME PRIVATE OWNERS IS BASIS FOR OPTIMISM

Experience in such fields as compensation insurance, industrial-safety requirements, and regulation of wages and hours shows that legislation for the general application of any new principle in social progress is enacted after a few progressive industrial leaders have established its value and practicability.

A few years ago it was estimated that forestry measures of one kind or another in addition to fire protection were being applied on perhaps 20 percent of the private-forest land. Since then the number of owners and operators inaugurating good forest management has increased. A wide interest has been displayed in the possibility of tying up with the national forests in cooperative sustained-yield units. As successful experience accumulates, the intensity of forest practice and of management plans increases. On several "tree farms" fire protection goes beyond either State or Federal practices. Some industrial properties are organized to permit successive cuttings on the same area at intervals as short as 10 years. So many commercial operators have now demonstrated that timber growing is a sound and attractive field for private enterprise, that the people should no longer forego the benefits from Nation-wide application of good forest prac-

tice that could be vouchsafed to them through appropriate public control.

What long-range forest planning can mean to local people and communities may be illustrated by the recent rejuvenation of one small town in the West. This community, established around a sawmill as a "company town," had prospered during the boom period of lumbering in the vicinity. A large remanufacturing plant added to the industrial activity. But then timber became scarce, the original owner died and the business came almost to a standstill during the depression. Houses and stores were unpainted and dilapidated. Public utilities were inadequate. The whole atmosphere was one of depression and discouragement.

This apparently hopeless scene was changed when a farsighted company operating a sawmill in an adjacent community decided to purchase the entire enterprise, including the town itself. Over 100,000 acres of cut-over lands and young growth have been organized as a tree farm on which to grow a new crop of timber to replace in part the supply that carried this town through its pioneer boom period.

Meanwhile, the town is to become the center of remanufacturing operations in a well-integrated industrial program based upon sustained-yield forest management plans. Permanence of operation has been the justification for large expenditures for improvement of both plant and town. Manufacturing facilities have been modernized. Some of the most unsightly buildings have been demolished. The company's office and store buildings have been painted. Public utilities have been improved. Dwellings have been sold to a real-estate company for resale to the workers under a contract that protects the ultimate purchaser from profiteering. The people have taken a new interest in their community and have organized to handle their own affairs. With generous cooperation from the company, the town was incorporated for the first time early in 1943. Thus a potential "ghost town" has been rejuvenated and given a fresh and confident outlook as a concomitant of the long-range forestry program of a major operating company.

It is in such sound communities, firmly geared to their basic resources, that the strength of American democracy lies. Here, stemming from plans to keep forest land productive, are the elements of both national and individual security.

EVIDENCE OF CONTINUED HIGH DEMAND FOR FOREST PRODUCTS

The urgency of protecting and developing the Nation's forests to yield as abundantly as is required for national security has been brought home by evidence from all sides that the demand for forest products is likely to remain at a high level. For the immediate future, demands for lumber for reconstruction abroad must be met on the basis of military necessity. There can be little doubt that huge amounts will be required before anything like a stable economy can be established in large sections of war-torn Europe.

In this country, once the stringency of war requirements is passed, an enormous pent-up demand for urban home construction will make itself felt. Starting from less than 300,000 units per year, this home building may easily rise to 900,000 new units per year in the 5 post-war years. On this basis the average lumber requirement for urban

homes alone would be 8 billion board feet annually. Farm building maintenance and construction, also in arrears, are likely to be stimulated to higher than prewar levels by increased farm purchasing power. These items may be expected to offset the sharp drop in military construction and in amounts needed for boxes and crates, so that total lumber requirements may well continue at wartime levels.

New techniques facilitating the use of timber should enable wood to hold its place in competition with other structural materials if an abundant supply is maintained. The upward trend in the utilization of pulp and paper products has by no means reached the saturation point. Chemical use, notably in the field of fermentation and plastics, holds large possibilities for utilization of pulpmill and sawmill waste and perhaps for small or low-grade timber.

Thus a continued high level of demand for forest products may be anticipated. Fully as important is the general level of industrial activity in the years ahead, which will be reflected in the demand for all basic resources, including forest products. Even though output has been limited by manpower shortages, the war has given some indication of the volume of wood use in an economy with gross national output of perhaps \$175,000,000. Many authorities agree that national income must be held at a level of perhaps \$140,000,000,000 to sustain the volume of employment essential to economic health. This is about double the national income of the immediate pre-war years. That forest-products industries will share in such a permanent expansion of our industrial economy can hardly be open to question unless inadequacy of timber supply should render them unavailable.

POST-WAR POLICY DEMANDS FORESIGHT

Prospective demand for forest products at a rate far in excess of present annual growth poses some difficult questions affecting national welfare. The Nation must consider to what extent and for how long the lumber we need can be obtained by continued liquidation of old growth. It must also consider whether the young timber now in sight is sufficient to maintain output in the face of an inevitable decline in the cut of old growth. It must decide upon measures that will be effective in prolonging the supply and assuring abundant new growth. For it is only by careful husbanding of the remaining old growth and proper management of existing young growth that we can hope to bridge the gap between exhaustion of the available supply and the fruition of whatever forestry program the Nation may follow. Failure in this will inevitably lead to drastic curtailment of consumption.

Thus, while not relaxing efforts to meet military requirements, the Nation must consider on what scale it can contribute to post-war rehabilitation abroad without unnecessarily jeopardizing its own future. Hasty commitments, based on the assumption that we still have plenty of timber, may aggravate critical local shortages, work hardships on individual workers and consumers, and undermine our future security. A farsighted policy in forestry is vital for national welfare.

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Forests and Employment

*Report of the
Chief of the Forest Service
1945*



United States Department of Agriculture

U. S. DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., October 15, 1945.

HON. CLINTON P. ANDERSON,
Secretary of Agriculture.

DEAR MR. SECRETARY: In this, my first annual report to you, I want to emphasize the importance of forestry in our national goal of full employment for the future.

Perhaps the outstanding lesson of the war is that abundant resources are the essence of national security and strength. Just as truly, the measure of possible employment in peacetime depends on the abundance of our basic resources.

By building up the productivity of our forests and ranges and fully developing all uses of these natural resources we may ultimately create 2½ million permanent new jobs—jobs on the land, in business relating to forest recreation, in the industries processing forest and range products, and in the transportation of forest products and livestock.

This is the goal and the justification for the comprehensive forest program in which the Forest Service is engaged.

We cannot build up forest productivity so long as destructive cutting practices are prevalent. Nation-wide regulation of cutting and other forest practices would give assurance that our land would be kept reasonably productive and thus help sustain employment.

We must increase the acreage of public forests and greatly intensify public forest management.

We must encourage and assist private forest landowners and operators in good forest practices and in the marketing of their products. In expanding aid to small owners we should encourage the establishment of cooperative associations and take care of those who own forest land not in farms, as well as the farmers. We must intensify protection against fire, insects and disease; adjust taxation so as not to impose inequitable burdens on owners of young timber; make loans on terms adapted to the long-time nature of timber growing; and we must strengthen our forest and range research to increase forest and range productivity, eliminate waste, and enlarge the utility of wood.

All these things will help create and sustain future forest employment. But before our forests can make their full contribution to the national welfare we shall have to do a large volume of work on both public and private lands. Recent estimates envisage the expenditure of \$2,215,000,000 in a program of public forest work that would keep 163,000 men busy for about 6 years. This work is needed to restore depleted forests and ranges to reasonable productivity, to open up virgin timber for commercial use, to build the roads needed for sustained-yield forest management, to improve the growth of young timber, to provide adequate protection from fire, to develop water and other improvements that will facilitate good range management, to prepare for a greatly increased volume of recreational use, and to install structures that will check runoff, reduce erosion, and help prevent the formation of floods. An even larger number of men than suggested for the public works program could be used for additional work along these lines on private forest lands.

During the war years we have subordinated our long-term objectives to activities contributing to war production and military use of forest products. Now it is time to gear our program to the needs of an expanded peacetime economy.

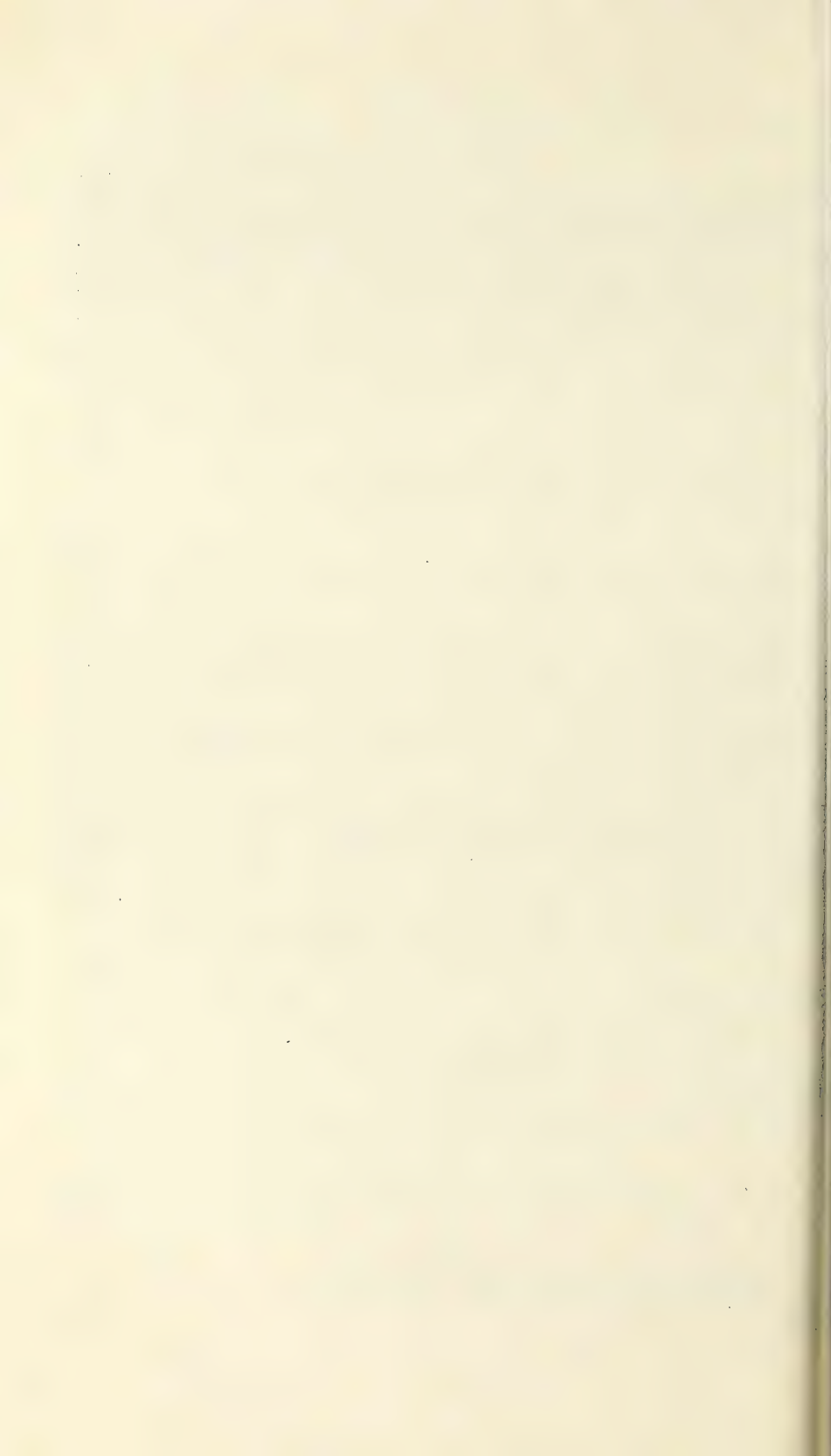
Sincerely,

Lyle F. Watts

Chief, Forest Service.

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Forests and Employment

Report of the Chief of the Forest Service, 1945

Jobs in the Forests

As the Nation enters the postwar era, its thoughts are focused more and more on the problem of full employment. This indeed is commonly regarded as the most critical issue facing our democracy. If veterans streaming home from the wars and workers released from war industries find jobs awaiting them, we can have peacetime prosperity that promises a standard of living higher than anything we have known before.

To achieve this goal of full employment—to give every man and woman who is able and willing to work the opportunity he needs—we must keep our industrial and agricultural plants in high gear. Our forests will have an important part in that objective. They can provide abundant and continuing supplies of raw material for many industries serving the people with an ever-widening variety of useful products. Through a comprehensive forestry program we can ultimately create as many as 2,500,000 permanent new jobs.

Forest Employment Can Be Increased

The forests of the United States now provide jobs for about 3,750,000 persons. In the woods, men cut and haul timber, plant and care for new forests, collect the gum of turpentine trees, man lookout towers, and build roads, trails, firebreaks and recreational facilities; they tend the livestock that graze in the forests, and do numerous other things. Processing the products of the forest furnishes even more employment than work in the woods—jobs in sawmills, pulp and paper mills, turpentine stills and other chemical plants; jobs in veneer mills, wood-reservation plants, box factories, furniture factories, and other wood-using industries. In addition, there are jobs in the transportation and distribution of forest and livestock products, in the stockyards and meat-packing industries, and in catering to people who come to the forests for hunting, fishing, and other recreation.

If the productivity of our timberlands and forest ranges were increased—as it should be—and if other resources of the forests were fully developed, the employment directly and indirectly furnished might be stepped up to as much as 6,250,000 persons. These figures do not include, as they might, the people employed in the manufacture of logging and processing equipment and machinery, in personal services and retail trade, nor the supplemental services of doctors, lawyers, teachers, and public servants.

Public Forest Work Will Broaden the Base for Permanent Employment

To help bring our forests and ranges into condition to sustain such an increase in the basic level of industrial employment, we should undertake without delay a comprehensive forest work program. The work needed to restore our depleted forests and run-down range lands, and to develop fully the many values that forests can bring, is worth doing as a first step in increasing the Nation's productive assets.

It can also be a potent instrument of fiscal policy and full employment. Positive action by the Government is likely to be needed to stimulate private enterprise and increase consumer purchasing power. Expanding public expenditures for the general welfare, including the conservation and development of forest and range resources, offers a major opportunity to increase purchasing power and at the same time build up the Nation's productive assets. When we build up our productive resources, we improve the chances of permanently providing full employment without resort to purely compensatory spending by the Government.

If we resume forest work of the kind for which legislation and precedent exist—such as that carried on before the war by the Civilian Conservation Corps and other relief programs—about 163,000 new jobs could be provided in the woods without delay. This program would call for an expenditure of about \$2,215,000,000 over a 6-year period. It would be confined largely to the publicly owned forests—Federal, State, and community—but would also include protection work on private lands. It would involve building a network of forest highways; gaining access to undeveloped areas through the construction of forest roads and trails; expansion of facilities for fire protection; tree planting; thinning, pruning, and improvement work in young timber stands; range improvement; upstream work to reduce floods; recreational improvements; and other types of work.

The volume of public forest work would be greatly expanded if lands now largely useless and idle were purchased and restored to full production by reforestation and improvement. Such additional work would employ over 30,000 men and would involve an expenditure of about \$500,000,000.

An even larger backlog of useful work is involved in the rehabilitation of run-down private forests and in the planting of thousands of miles of shelterbelts on the great treeless plains west of the Mississippi. If this were undertaken in a 6-year program, it would give employment to almost 150,000 men. It would cost about \$2,350,000,000.

Thus, essential work to protect and develop our forests can keep almost 350,000 men busy for about 6 years. But the value of such work goes far beyond the jobs it can furnish for the reconversion period—it would expand the base for the high level of permanent industrial activity upon which full employment depends.

The Forest Service and the Nation's Business

Because it deals with a basic natural resource that serves industry, agriculture and human welfare in so many ways, the work of the Forest Service has a vital relation to our national goal of full employment. The Forest Service administers 179,100,000 acres now included

in the national forests. It conducts research in various aspects of forest and range management, forest products, and forest economics. It cooperates with the States in providing protection to State and private forest land. It works with farmers, forest industries, and other landowners to bring about better forest practices and increase forest productivity. It is concerned with the conservation and best use of about one-third of the total land area of the country.

The work of the Forest Service is of immediate benefit to private enterprise in numerous ways. Cooperative forest fire protection, for example, is an essential service to forest landowners. It reduces one of the major risks in holding land for timber growing. It is also valuable to small sawmills and other rural forest industries. And its benefits extend to industries only indirectly dependent upon the forest.

The Forest Service assists private owners in developing plans for timber growing. It provides valuable guides to timber operators, lumber mills, and other forest industries by collecting statistics on supply, prices, and output of forest products.

Forest Service research—to cite another instance—is of immense usefulness to industry through the development of better techniques in growing timber, seasoning and fabricating wood, and creating new products. Forest Service research also serves livestock owners and ranchers. It has developed techniques in the management of range lands that enhance the profitableness of their operations.

The national forests are themselves important to industry. Timber cut on the national forests represents 10 percent of the Nation's total lumber output. Many industries are entirely dependent on national-forest timber; others need national-forest timber for sustained operations. National-forest range lands, furnishing feed to 10 million animals, are a considerable factor in the western livestock industry. Their productivity also affects the great meat packing industry and the farm feeder business of the grain belt. Water that flows from the national forests is the lifeblood of irrigated agriculture. Through watershed protection, the national forests are vital to large segments of the electric-power industry and to the far-flung industries that use hydroelectric power. Many communities are dependent on the national forests for their municipal water supply. Finally, the wild-life and recreational values of the national forests are important factors in industries supplying equipment, clothing, and other things used by sportsmen, tourists, and vacationers.

Public Understanding and Progress in Forestry

An adequate forest program for the Nation must be supported by informed public opinion. For example, a continuing educational campaign is required to prevent and minimize forest fires that now kill an average of 3 billion feet of timber annually and tie up enough labor to maintain 2,800 miles of main-line railroads. And there are many other phases of forest and range land management and of public forest policy that should be more widely understood.

The Forest Service has accumulated a vast fund of information in administering forest, range, and watershed lands, and in coping with the many problems involved in their protection, development, and use. There is a continual demand for this information from people engaged

in producing, processing, distributing, and using forest and range products; from groups interested in watershed protection, wildlife, and recreation; from State and Federal government agencies; and from educational institutions, publicists, and others.

To keep the public informed of our forest and range land situation, and to cultivate an understanding of the deep and complex relationship of such lands to our industrial and agricultural economy and to the country's security and well-being, is an important obligation of the Forest Service.

The public must understand that forest conservation has a vital place in providing employment not only in the reconversion period, but also in the more distant future. It must realize that a high level of future forest employment requires that our forests be in condition for permanent production. Thus, while reporting on the year's accomplishments, and discussing problems and activities in terms of a sustained timber supply, greater range production and other benefits and services of the forest, the succeeding sections bear directly on the opportunity and goal of full employment.

The Place of Public Forests

National security demands that a substantial backlog of timber be kept in public ownership. Under public ownership, trees can be grown to larger size than may be the rule on private lands. This is one way of assuring a reasonable future supply of high-quality timber—of which there is a growing scarcity—as well as an abundance of timber of all kinds for ordinary needs. It is one way of underwriting an adequate level of forest employment.

To give stability to forest landownership and policy, public forests should be expanded at three levels of Government: Federal, State, and community. Each has a place in a comprehensive national program of forestry.

On millions of acres, liquidation of timber values or destructive fire has rendered the land unattractive for continued private ownership. In some regions, a large acreage of cut-over and depleted forest lands is tax delinquent. Additional thousands of acres still uncut in regions of scanty rainfall, poor soils, or extreme inaccessibility, will offer little or no incentive for continued private ownership after the present stand is cut.

Public ownership must be a major factor in the forest economy of the future because the public interest in forest lands is so much broader than the cash income that attracts private owners. Much land primarily valuable for watershed protection—whether to assure a steady flow of water for irrigation, to protect domestic or municipal water supplies, to minimize flood damage, or to safeguard navigation—should be in public ownership. Public forests also make land of special recreational value available for the enjoyment of people in all walks of life.

National Forests Should Be Extended

Consolidation of Existing Units—An Unfinished Job.—In the national forests we see the first large-scale attempt at public owner-

ship and operation of forest lands in this country. At present the national forests encompass a gross area of 228,643,000 acres, of which 179,100,000 acres are in Federal ownership or in process of acquisition. Of the remaining 49½ million acres, some 35 million are deemed chiefly valuable for national-forest purposes. A large part of this acreage lies in the national-forest and purchase units of the East. In 44 of 73 units established under the Weeks law of 1911, 50 percent or more of the land is still privately owned. Even in some of the older national forests created from the public domain in the West, as much as 40 percent of the gross acreage is in private ownership as a result of land grants to railroads, settlement, and other alienations.

During the war, Federal appropriations for the purchase of lands for national forests were cut off. However, during the past year a total of some 200,000 acres was added by exchange and donations.

Additional National Forests Desirable.—Estimates worked out before the war in consultation with the States, indicate that millions of acres outside of the present national-forest boundaries should be brought into Federal ownership, in order to assure the kind of management and protection that will best serve the public interest. The Federal Government should be willing to take over land that private owners find uneconomic to hold when it occurs in units suitable for national-forest purposes. This will be doubly important if public regulation of cutting practices is embodied in Federal laws.

Perhaps 1¼ million acres of land chiefly valuable for national-forest purposes, acquired by the Army for military use, may become available soon under the Surplus Property Act of 1944. Special legislation should be enacted to incorporate such lands into the national-forest system, if and when they are released by the military authorities, without transfer of funds from one Federal pocket to another.

National Forests and Revenue of Local Governments.—While there is need for consolidation and expansion of the national forests, local government officials have expressed increasing concern over the effect of continued Federal purchases on the local tax base. This concern was heightened during the war by military purchases of land of substantial value and productivity. In normal times, a considerable part of the lands purchased in the national-forest program are tax delinquent, or at best yield very little tax revenue. Although the original national forests created from the public domain were never on the tax rolls, Congress provided that 25 percent of all national-forest receipts shall be returned to the States for distribution to counties containing national-forest lands, as a contribution in lieu of taxes. An additional 10 percent of receipts are used locally for construction of forest roads and trails.

Several proposals for revision of the method of making contributions to local governments have been before Congress in recent years. While the subject is complex, it is exceedingly desirable to find a simple and easily applicable solution that will provide more uniform and dependable support for local governments than the present system. In some States, local officials have protested exchanges or purchases, which they admit are otherwise desirable, in the hope that action on the contributions question will be expedited.

State Forests

Interest in the extension of State forests has increased markedly in the past few years. This stems in part from a feeling, extending far beyond the realm of forestry, that the political power of the States should be strengthened and that the influence of the Federal Government should not be further expanded. This point of view has been strongly expressed in some of the Western States, where the Federal Government already owns a substantial proportion of the land. But the more active interest in State forests also reflects the strong financial position in which many of the States now find themselves. New laws authorizing acquisition and management of State forests have been adopted recently in a number of States; others, notably Connecticut and Ohio, have made much larger appropriations for State forests than ever before.

There is no essential conflict between State and national-forest programs. National forests are acquired only after the boundaries of purchase units have been fixed in consultation with the States. National forests are generally established where the land use problem is larger than the States can effectively handle, or where interstate interests such as those involved in watershed protection, must be protected. State forests, on the other hand, may well be in smaller units than national forests. They may be planned to meet local problems, such as the abandonment of submarginal farm lands, or to provide adequate forest recreation close to large centers of population.

State forests may logically be used as a means of stabilizing ownership and restoring values to lands that become chronically tax delinquent. Most States lack a constructive policy for handling tax-delinquent lands. In private hands, they often present a social as well as an economic problem. In public ownership, they may be restored to productive condition and developed for public enjoyment and use.

State forests now comprise some 9,302,000 acres in 37 States. Other State-owned forest lands aggregate 10,124,000 acres. In addition almost a million acres of federally owned lands are under long-time lease to the States for management. In all, there are some 6,700 State-forest units. About two-thirds of the combined area is under some form of silvicultural management.

The State forests do not include all the acreage in game preserves, State parks, etc. New York, for example, has 2,404,000 acres in two State forest parks that are held in their natural state primarily for recreational use.

County-owned forest lands in 23 States total almost 7 million acres.

Community Forests

In terms of human welfare, community forests assume greater importance in the Nation's forest program than the forest land area they occupy would indicate. There are 2,278 communities in the United States that have forests; altogether these comprise 3 million acres, two-thirds of which are in 30 of the larger units. Most of the community forests are small properties of 100 acres or less, located within easy reach of centers of population.

The chief value of these many small forests lies in the fact that they are local institutions which the people themselves have established for the improvement of community life and environment. The citizens of some communities have improved their forests by contributing their own labor to plant trees, build roads, cut wood, and do other forest culture.

Community forests afford opportunity for people in all walks of life to gain some appreciation of the relation of forests to the industrial and cultural life of the country, and so become better prepared to think clearly on national forestry issues.

Other benefits of community forests take the form of protection for the domestic water supply, a source of wood for people on relief, a backlog of work for the unemployed, or a place for outdoor recreation. Schools use them as nature laboratories. Community forests may appropriately be established as living memorials to local men who gave their lives in the war.

Community forests are often started by planting abandoned farms or caring for cut-over woodlands, and so do not produce much income from timber for many years. In the course of time, however, the larger community forests, like many of those in European countries, may contribute significantly to the support of local governments.

The Nation's Timber Supply

Predominant in the contribution of the forests to employment is their service as the Nation's timber supply. An abundant timber supply, perpetually maintained by good forest practices, will provide the basis for thriving industries and prosperous communities.

Need for Perspective

Forest employment and the stability of forest communities are local problems. When the timber in any locality plays out, employment in the woods disappears. Some forest industries may be maintained by bringing in logs or other raw material from distant localities, but there is an economic limit beyond which it is not practicable to ship raw forest products. Hence we must look primarily to local timber crops to maintain local forest industries.

Nevertheless, it is important to view the Nation's forest problem in its entirety in order to get a proper perspective on over-all requirements for forest products, regional timber-growth possibilities and local responsibilities for timber growing.

All too often, people think of our timber supply in terms of exploitation of the virgin stands of the Pacific Northwest. It is easy to be complacent when told that the stand waiting to be cut is enough to maintain current lumber output for 50 years. But such a view overlooks the many communities already in difficulty because of timber depletion. It slights the large proportion of existing sawmills whose timber supplies will suffice for not more than 5, 10, or 15 years. It disregards the output of products other than lumber and the losses from fire, insects, and disease. It fails to recognize how large a volume of standing timber must be kept on the ground as growing stock, or forest capital, to assure a perpetual crop.

In the South, the prevalence and vigor of second-growth pine has led to great optimism about the future. Second growth has enabled the region to maintain a high lumber output, even though most of the big mills that operated in the virgin timber have been dismantled. It has enabled the South to build up within a decade a pulp and paper industry using 7 million cords of wood each year. But satisfaction with the persistence of forest products industries after the exhaustion of virgin timber should be tempered by consideration of whether—without better forestry—the young growing stock can sustain indefinitely the demands now being placed upon it. And satisfaction with current growth should not cloud our vision of how large a part of the Nation's future requirements should be produced in the South. There is every reason to believe that the South can and should double its annual timber crop.

In the North, where lumber output in many formerly important producing localities has been reduced to insignificance, there is a tendency to view the situation solely in terms of the present condition of the depleted and deteriorated forest. Too often, the northern view is satisfied with a forest economy directed chiefly to the production of pulpwood and other small timber for chemical conversion. Actually, a balanced forest economy for the Nation may call for the restoration of a more substantial lumber industry near the great industrial centers of the North. Such an enlarged view of northern forest possibilities would benefit the region by providing more diversified employment locally.

The Forest Service must deal with the over-all forest problem of the Nation, and it must envisage the situation in each region as part of the national problem. Furthermore, it must deal with all aspects of the problem in each region and for the country as a whole. It must be concerned with both public and private lands. It must seek to correlate farm and nonfarm production. Its effectiveness would be greatly impaired if it were concerned only with public forests, or if it were not closely integrated with other agricultural activities.

Timber Growth Must Be Increased

During the past year the Forest Service has undertaken a reappraisal of the Nation's forest resources in order to evaluate progress, check up on trends and redefine objectives and policy. While results of this reappraisal will not be available until next year, there is no question as to the basic facts in our forest situation.

Forest depletion is serious. Wartime timber cutting and losses were about 50 percent greater than annual timber growth. Closing of important sawmills, in spite of the pressure to maintain output during the war, testifies to the inexorable march of forest depletion that can not be much longer offset by the opening up of new bodies of timber. Commercial operations have all too commonly been marked by destruction of young stands that might have yielded substantial quantities of wood from thinnings, while continuing to put on merchantable growth for the future.

To understand our forest situation, attention must be focused on the character and amount of growing stock in relation to present and

prospective needs. We have plenty of forest land to take care of every prospective need. The crux of our problem lies in stopping destructive cutting and in building up and maintaining the productive growing stock. Only in this way can forest employment be protected.

In the East, which contains 75 percent of our commercial forest land, the best estimates we now have indicate that the present stand is far less than the volume of growing stock necessary to assure an annual crop equal to prospective timber requirements.

To help bridge the gap until second-growth forests are ready to support a larger output, we should use the supply of virgin timber in the West carefully and efficiently. The more rapid the liquidation of this virgin timber, under the pressures to maintain current output, the more drastic will be the inevitable curtailment in the use of forest products a few decades hence and the more adverse the impact on employment.

Public Regulation Will Help Sustain Forest Industries

The need for positive action to increase annual timber growth so that employment in our forest industries will not be jeopardized by lack of raw material has led the Forest Service to recommend that cutting and other closely related forest practices on private lands be subject to public control. The Forest Service believes that the Federal Government should establish standards of forest practice which would stop premature cutting and other destructive practices and keep the land reasonably productive. It proposes that the Federal Government extend financial aid to States that enact regulatory legislation and enforce specific cutting rules conforming to the Federal standards; and that the Federal Government should itself regulate forest practices in States that fail to do so within a reasonable number of years.

The expansion of public ownership, envisaged in a previous section of this report, will still leave the most productive half of our commercial forest land in private ownership. We cannot rely on educational programs alone to get 4 million timberland owners to practice good forestry, and without the community protection afforded by public regulation there is always uncertainty about the continuity of private forestry. So public regulation is also needed. We must use every tool at our disposal to help increase the Nation's timber growth.

Industrialists who are concerned about a plentiful future supply of raw material should welcome public regulation, which will tend to maintain the flow of merchantable timber from the hundreds of thousands of small woodland holdings that play such a vital part in the Nation's timber supply.

We must remember our experience in older lumbering regions, where forest industries and employment have dropped to lower and lower levels as growing stock dwindled under the impact of successive waves of cutting, each taking trees of smaller size or poorer quality than its predecessor. Expansion of the pulp and paper industry and the prospect of new forms of chemical utilization of wood foreshadow a similar decline in forest growing stock and shrinkage of forest industries in localities where the spiral is still in its early stages.

The Demand for Lumber and Other Forest Products

Lumber seemed very important in World War I, when over 6 billion board feet was used for war purposes in 18 months. However, World War II required this amount of lumber every 4 months for 3½ years. In 1942, requirements for military construction, shipyards, new industrial plants and war housing dominated the picture. After that, boxing, crating, and dunnage came to the fore, taking about half of our entire lumber output. Requirements for these purposes jumped from 4½ billion board feet before the war to 15½ billion board feet in 1943. They were near that level when Japan surrendered.

During the war, lumber consumption consistently outstripped sawmill production. This made it necessary to draw heavily on stocks in the hands of manufacturers, concentration yards, wholesalers, and retailers. Total lumber stocks at the end of 1941 were estimated at about 17 billion board feet. By the end of 1944 the Nation's stock of lumber stood at only 6 billion board feet.

It is expected that demands for forest products will continue at a high level.

Lumber needed for domestic consumption in the first postwar decade is estimated at an average of 33 billion board feet annually—a rate almost equal to wartime consumption, and some 10 percent in excess of the 1920–40 average. Residential construction is expected to call for 10 billion board feet annually. Additional large demands are anticipated for farm buildings, for industrial reconversion, for boxes and containers, and for long-deferred repairs to all types of structures.

Need for lumber in other parts of the world will also be great. In rebuilding the devastated cities of Europe and the Orient, and restoring industrial output in war-ravaged countries, vast amounts of lumber and other construction materials will be required. This may mean additional pressure to increase output in the United States.

Wood requirements for pulp and paper are also expected to remain at levels far above prewar production. The anticipated demand for domestic pulpwood is placed at 14.5 million cords annually, or 1.3 billion cubic feet. More than half of the paper consumption of the United States before the war was accounted for by imports of paper, pulp, or pulpwood. Pulp and paper plant capacity has been greatly increased during the past decade, particularly in the South. Additional installations are planned. It is doubtful if imports will ever exceed prewar levels. Thus our enlarged wood requirements must be met from American forests. Alaska may play an important part in further expansion of our paper industry.

Anticipated requirements for other forest products, including veneer and plywood, fuelwood, posts, poles, piling, shingles and other materials, average about 6 billion cubic feet annually—nearly as much as the requirement of 6.5 billion cubic feet for lumber.

Total domestic needs during the first postwar decade are expected to average about 13.8 billion cubic feet annually. To this must be added perhaps 2 billion cubic feet of losses from fire, insects and disease. Looking several decades ahead, and making allowance for new uses and exports as well as losses, we should aim for an annual timber crop of over 20 billion cubic feet. This compares with annual growth estimated in 1938 at only 11.3 billion cubic feet. The deficit is ag-

gravated by the fact that much of the present forest growth is not in timber of the size, species, and high quality demanded by users.

Prospective long-time requirements for forest products can be met only through prompt action to bring about more complete utilization of the timber cut, better protection of remaining forests from fire and overcutting, and forestry practices that will build up growing stock.

Timber from the National Forests

Demand for National-forest Timber.—In recent years, the timber resources of the national forests have taken an increasingly important place in supplying the Nation's forest products. In the years ahead, national forest timber will be even more indispensable.

The national forests contributed about 5 percent of the total lumber cut in 1939. Since then, the proportion has been constantly increasing and is now about 10 percent. In fiscal year 1945, 3,145,000,000 board feet of national-forest timber was cut in sales or exchanges, a 5.6 percent decrease from 1944. This decrease, caused chiefly by shortage of woods workers and logging equipment, compares with a 10.3 percent decline in total lumber production for the country as a whole.

In numerous communities primarily dependent upon sawmills the national forests are now the main source of logs. By bridging the gap between the exhaustion of old-growth private timber and the time when second growth will be ready for cutting, national-forest timber is often the key to community stability. When needed to keep mills in operation that would otherwise have to be shut down, national-forest timber will be sold up to the sustained-yield capacity of the forest. During the past year, 28 sales were made without competition under wartime authority, to keep in production sawmills that otherwise would have had to curtail output, or close down for lack of stumpage.

To bolster the Nation's lumber output further, national-forest timber will also be advertised for cutting in undeveloped localities, where there are sound opportunities for expansion of forest products industries. The cut from the national forests could easily be increased to around 4 billion board feet annually in the near future.

Although our staff has been overloaded in administering the heavy current timber-sale program, work has gone forward in the development of cooperative sustained-yield units for integrated operation of private and public timber under Public Law 273 of the Seventy-ninth Congress. Some general surveys were followed by preliminary discussions with interested operators and communities. Inventory taking and unit analyses were started on a few of the most promising cases in Washington, Oregon, Idaho, Montana, California, and Louisiana.

Fighting Forest Insects and Disease.—Reasonably good progress has been made in the fight against white-pine blister rust in 1945. High school boys, Mexican nationals, agricultural workers in off-season periods, and prison camp labor, were recruited for this work. Over a million acres within the areas where control measures are needed, chiefly in Idaho, Montana, and California, are as yet unworked.

Insect epidemics were at a low stage in 1945, except in Colorado, where a serious outbreak of spruce barkbeetle has continued unabated.

Rather intensive but localized barkbeetle infestations in ponderosa pine were fought in Idaho, Utah, and California.

Planting to Increase Future Timber Production.—Anticipating a large postwar program of reforestation, work was undertaken in 1945 to bring about half of the Forest Service nurseries back into production at a rate which, by 1947, will provide for the planting of around 150,000 acres of denuded lands annually. The Forest Service aims to complete in 15 years the planting of the $2\frac{1}{4}$ million acres of denuded land in the national forests. In addition, about 1 million acres of national-forest land needs supplemental or fill-in planting to make it reasonably productive.

Planting should be recognized as an integral part of national-forest administration. It should be financed in the regular budget so that interrelated operations, extending over a period of about 5 years between seed collection and field planting, may be conducted efficiently. Essential thinning and pruning operations should also be a part of the regular job of national-forest administration, regardless of the general level of employment. There will still remain a vast pool of timber cultural work which can be undertaken when there is need to sustain employment by expanding public work.

Private Lands—The Primary Source of Our Forest Products

Although the national forests are destined to supply a much larger part of our timber needs than they did before the war, the Nation must continue to rely primarily on timber from private lands. They are our main source of forest employment. Three-fourths of our commercial forest lands are in private ownership; these supply over 90 percent of the output of all forest products. The condition of private forest lands is therefore a matter of vital public interest.

Private Timber Dwindling.—During recent years attention has been called frequently to the steady depletion of our forest resources. The reduction of almost 40 percent in our sawtimber volume in the 30 years prior to the war reflects primarily the depletion of private supplies; public timber made small contribution to output in that period.

Dwindling timber supply has been the cause of drastic shifts in the forest industry. For example, lumber cut in Pennsylvania, once the leading source of the Nation's supply, has dropped to only 1 percent of the total. Output of lumber in the Lake States, which used to produce $8\frac{1}{2}$ billion board feet annually, did not get above $1\frac{1}{4}$ billion feet under wartime pressure. In Virginia, sawtimber scarcity is reflected in a decline of lumber output to half of what it was in 1910. Even in the deep South, where lumber output is still high in spite of the virtual exhaustion of virgin timber, the dwindling timber supply is a critical factor locally in such areas as western Florida, northern Mississippi, and northeastern Arkansas.

Even more revealing is the mounting evidence of the extent of timber depletion in the West. Mills representing 60 percent of the present sawmill capacity in Washington and Oregon do not have private timber to operate more than 15 years. Some of these mills can obtain public timber to prolong operations. And as others close, the remnants of their timber will become available for those that remain. But lack of timber will inevitably force the closing of many mills in the next

few years. In the past year, in fact, several large sawmills in the Pacific Northwest did close because they were running out of timber. New mill installations in southwestern Oregon, which has only been opened up to large-scale lumbering in recent years, will help sustain total output for the time being. But southwestern Oregon already has more sawmills than its forest lands can permanently support. And developments there cannot offset the adverse effects of timber depletion upon the communities in the cut-over sections further north.

Progress in Industrial Forestry.—Some farsighted leaders in the forest products industries realize that the timber supplies needed to keep them in business in future years must be grown as a crop. The National Lumber Manufacturers' Association, through a number of its leading affiliates, is engaged in a far-reaching campaign to designate industrial forest lands dedicated to timber growing as "Tree Farms." After 3½ years this movement has been reported to include 812 properties embracing 10.7 million acres. Of this, about 1.4 million acres were dedicated during the first 6 months of 1945. Of the total, 106 properties with 4.1 million acres are in the 5 Northwestern States and 706 with 6.6 million acres are in 5 States of the southern pine region. The western Tree Farms average almost 40,000 acres in size, and those in the South almost 10,000 acres.

Before the lumber industry launched its Tree Farm movement, the pulp and paper industry of the South inaugurated a pulpwood conservation program to maintain forest productivity by improving forest cutting practices. This program was interrupted by the war, but war-time competition for stumpage has increased the concern of the pulp and paper industry about its timber supply. In the South as well as the West, many operators have been increasing their forest land holdings so as to have greater assurance of a steady flow of raw materials.

Efforts of the forest products industries have been largely confined to the larger landowners. While these are an important group, it is easy to be misled as to their weight in the Nation's forestry situation. Actually, the few thousand owners with more than 5,000 acres each account for only about one-third of the 341 million acres of commercial forest land in private ownership. More than one-third is included in some 3½ million farm woodlands; the remainder is held by hundreds of thousands of small nonfarm owners.

Forest Service Aid to Private Owners.—Ever since 1898, the Department of Agriculture has offered technical assistance to private owners in the management of their forest lands. Ten years ago the effort to improve practices on nonfarm forest lands was given new emphasis and formalized under a Division of Private Forestry Cooperation in the Forest Service. Since 1938, this division has worked with owners of 19.7 million acres of forest land. Many of these owners have employed competent forestry staffs and are going ahead on their own. Some of the acreage is now included in Tree Farms.

All this is encouraging, but because of inadequate appropriations for the work, it has been impossible to reach even 1 percent of the nonfarm owners. Our efforts have been directed primarily at the larger operators where, it was believed, a small amount of work would exert the most far-reaching influence.

But the private forest land in large ownership, even if all under good management, will not supply the Nation's need for timber, nor sustain even the present level of employment in our forest industries. We must face up to the job of reaching some 4 million small owners to assure a steady flow of forest products from the bulk of our commercial forest lands.

The Department has several programs to aid farmers in the management of their woodlands. But the small nonfarm owners present an almost untouched field. They cannot be served by the farm programs and they are largely neglected by the organized forest industries. A few State forestry departments have set up service for this group on a small scale. Since small nonfarm owners control almost a third of the private forest acreage, our forest problem will not be solved until we get to this group.

Closely associated is the problem of reaching the thousands of small-sawmill owners and independent logging contractors, who are seldom members of manufacturers' associations. Few of these have any proprietary interest in the forest. Yet almost a third of all the lumber cut in the United States comes from mills producing less than 1 million board feet annually. Many of these small mills are inefficient and poorly managed. Only 3 percent of the 39,000 sawmills in the country produce more than 5 million board feet a year, and some of them depend upon independent logging contractors.

The Timber Production War Project showed that much can be accomplished by educational work with small-mill owners and independent logging contractors. But the educational process is too slow to be effective in sustaining an adequate flow of forest products. In no other segment of the Nation's forest problem is the need for public regulation of cutting and other forest practices so clearly evident as in the case of small owners, small logging contractors, and small sawmills.

Farm Timber—A Major Factor in Forest Employment

One-Third of Timber Cut Comes from Farms.—The importance of the farm woodlands is likely to be underestimated in popular thinking. The large commercial holdings are usually regarded as the dominant source of the Nation's timber. In the West, attention is further diverted from the farm woodlands by the importance of public timber. Yet, for the country as a whole, farm woodlands have a greater acreage of commercial forest land than the national forests. In spite of the fact that their present productivity is only one-third to one-half of what it might be, the commercial farm woodlands supply about one-third of our national cut. They have always been our principal source of fence posts and fuel wood, items for which we use about three-fourths as much timber as for lumber. Now lumber, timbers, poles, piling, cross ties, pulpwood, and other products are coming from the farm woodlands in increasing amounts.

Timber Crop Vital in Farm Economy.—The relation of farm woodlands to farm business also needs wider recognition, even in agricultural circles. Farm forests occupy a substantial proportion of all land in farms—in some States more than half. Timber will grow on land unsuited for other crops—on steep or eroded hillsides, on poorly drained bottom land, and on light, sandy soils. Timber can be har-

vested during seasons when other work on the farm is slack, and it does not commonly suffer from seasonal variations in the weather. The timber crop can net as much as \$2 to \$3 per acre per year, which compares favorably with some crops that demand much more labor.

Timber not only yields cash for stumpage; it also offers an opportunity for income from cutting and hauling, and from jobs in local sawmills and other wood-using industries. Farmers can often increase their woodland income two or three-fold by using their own labor to get the products to market, just as they ordinarily do with other crops.

Timber growing has special significance in the solution of the cotton adjustment problem in the South. A surplus of potential production of cotton for world markets is aggravated by a surplus of labor resulting from the use of mechanical cultivating and harvesting equipment. This dooms thousands of small farms with small fields where machinery is difficult and costly to operate. Timber should take its place with cattle, perennial hay, forage crops and grains in a better balanced farm economy for the South.

Forest Farming Has a Place in the Future.—In the naval stores region of the South, some farmers now obtain their main income from pine gum and pulpwood. As successful experience accumulates, forestry is likely to be adopted much more widely as a major farm enterprise. In some localities, forest farming may offer better opportunities than other types of farming for the thousands of men who—as we know from experience in previous periods of demobilization—will seek to settle on the land.

There is strong evidence that the food the United States can reasonably consume may be produced for years to come without expanding the acreage in cultivation. Thus the demand for farms is likely to be far in excess of the sound opportunities.

In contrast to this, timber growers face a period of increasing scarcity. We must double timber growth to meet prospective requirements. Small-scale forest farming on good sites may, therefore, meet an important need.

How the Department of Agriculture Promotes Farm Forestry

Forestry in the Extension Service.—For more than 20 years the Department of Agriculture has recognized farm forestry in the cooperative work of the State Agricultural Extension Services. County agricultural agents offer an effective means of interesting farm people in forestry. Under the guidance of State extension foresters and in connection with other farm programs, many county agents promote improved management of farm woodlands and offer advice on tree plantings for windbreaks, shelterbelts, erosion control, Christmas tree crops, and the like. Other phases of the work include the marketing of farm timber, wood preservation, 4-H club work, fire protection, naval stores, maple-sirup production, and rural building construction.

Cooperative Farm Forestry Projects.—The Department also cooperates with the States through the Forest Service in employing 100 resident foresters to aid farmers in 403 counties in marketing forest products and in proper management of their woodlands. All but 14 of these projects are directed by the States. During the fiscal

year 1945, these project foresters facilitated the cutting of 411 million board feet of timber that were either marketed or used on the farms. In addition, 5,780 barrels of gum and 7,100 gallons of maple sirup were harvested with the aid of project foresters.

Without such service, farm woodlands are commonly cut clean, with no prospect of additional forest crops for several decades. With such service, the farm timber is marked and measured before cutting. Mature, crowded, crooked, and defective trees are generally removed, leaving a vigorous stand for future growth. The farmers are also assisted in obtaining competitive bids from loggers and millmen, and in the preparation of a simple sales agreement that will protect the interest of both farmer and purchaser. The program is becoming popular with millmen as well as farmers, since buying known quantities of marked timber saves time and minimizes operating risks. Millmen also find that selective cutting means larger logs and lower costs.

Forestry in Other Bureau Programs.—Farm forestry is encouraged in other Department programs. The Soil Conservation Service includes forest planting and woodland management in farm plans prepared for Soil Conservation District farmers.

The Federal Land Banks are now authorized to take the productiveness of farm woodlands into consideration in determining the soundness, amount, and period of farm loans. The Forest Service assists in training Land Bank appraisers in valuing farm woodlands for loan purposes.

The Agricultural Adjustment Agency offers payments to farmers in some States for protecting farm woodlands from fire and overgrazing, for timber-stand improvement, for forest planting and for certain naval stores operating practices. The Forest Service administers the Naval Stores Conservation Program.

We have only begun to accept the challenge and meet the need for constructive service through all the foregoing channels. The small owner is so commonly at a disadvantage in the disposal of his forest products, and in financing long-term forestry plans, that the assistance offered by the Government should be greatly strengthened, especially by providing resident foresters to serve small owners, whether farmers or not, in every county that may qualify for cooperative aid.

Industry Assistance to Farm Forestry

A number of pulp and paper companies and several railroad systems provide direct assistance or educational programs for farm woodland owners. Tree seedlings from company nurseries are supplied free to farmers in several Southern States. Some of these companies provide foresters to mark farm timber before cutting by their contractors. This type of worthwhile aid could be greatly expanded.

Several large railroad systems have recognized the importance of wood from farm woodlands in their annual freight load. They have promoted, through advertisements, pamphlets, posters, and exhibit trains, better fire protection and conservative cutting. Such efforts are highly commendable, but they cannot eliminate the need for trained foresters working directly with farmers.

Better Utilization—One Answer to Prospective Timber Shortage

Forest Waste Now Enormous.—Better utilization of the forest crop can aid in closing the gap between annual growth and annual drain, and thus help in part to offset a prospective timber shortage and the resultant loss of employment. Under present harvesting methods, huge volumes of wood are left on the ground—tree tops, broken trunks, cull logs, and inferior species. Tremendous waste also occurs at the sawmill and factory in converting the logs or lumber into useful wood products. Woods losses are especially heavy in hardwoods, in Douglas-fir, and in the mixed stands of pine and other species in California and the Northern Rocky Mountain States.

The principal reason for logging waste is that it costs more to collect material left on the ground and move it to market than it can be sold for. Improvements that will reduce the cost of felling and bucking, assembling the material, and transporting it, must be effected if this potential supply is to find its way into commercial channels. Many species are not harvested because their properties, form, and size are relatively undesirable, or because changes are required in current conversion methods if they are to produce acceptable products. On the other hand, forest depletion and technological progress have brought many species once considered inferior and useless into the market. The utilization of other neglected species can be greatly accelerated by continued efforts to remove the technological obstacles that make them unpopular or unmarketable.

Diversified Industries Reduce Woods Waste.—All too frequently, the guiding principle in the establishment of forest industries has been the availability of timber for the production of a single product, such as lumber or wood pulp. Harvesting is confined to certain species, sizes, and quality, with the remainder unused or wasted. The cure may be found in diversified manufacture, so that in any locality the species and grades that make up the forest and that ought to be cut will be used for whatever products they are best suited. Utilization should also be complete, so that the waste or byproducts of one plant becomes the raw material of another. All this would increase the number of jobs.

Diversified and integrated utilization has been partially developed in a few localities, but the idea of planning industries to provide outlets for what we grow, rather than using the forest simply as a mine from which certain specially prized materials could be extracted, needs greater stimulation. A cooperative arrangement between three lumber companies and one large paper company in eastern Texas, aimed at integrated harvesting of pulpwood and sawlogs from all their lands, is a step in the right direction. The diversified industries at Crossett, Ark., and at Cloquet, Minn., illustrate further development of these possibilities.

New Processes Use Mill Wastes.—The tremendous quantities of potentially useful material now going to waste in sawmills and wood-using industries challenge our technical resourcefulness. The largest present single outlet for such wastes as sawdust, shavings, slabs, edgings, trimmings, and defective cuttings, is as fuel for the mill's power plant and for domestic heating. But because of their low value in

relation to bulk, such mill wastes cannot, as a rule, be shipped far. New processes for industrial utilization of such waste would add to employment possibilities.

Wood cellulose can be readily and cheaply converted to sugar which fermented, will yield 50 to 60 gallons of industrial alcohol per ton of dry wood. But to do this economically requires an investment of millions of dollars, and access to waste in huge quantities. For example, a commercial plant now being erected in a leading lumber center of the Northwest will produce about 4 million gallons of alcohol annually and will require about 225 tons of waste daily. Such quantities are available at reasonable cost only near large sawmills.

Means are also needed for utilizing the wastes and byproducts of chemical pulping processes in which roughly only 50 percent of the weight of the wood is recovered in useful products. About one-half of this waste is lignin and the remainder hemicellulose. A small percentage of the enormous lignin residues from pulping processes is now being utilized, but finding profitable uses for the remainder is one of the most important waste problems. Research has indicated the possibilities of converting hemicellulose into many products, such as adhesives, butanol, acetone, and ethanol; but further exploration and development is needed to determine the practicability of such processes.

Research—the Key to Better Forestry

Forest Cutting Practices Must be Based on Research.—Forest management research points the way to continuous crops of timber. A few examples will illustrate this point:

In Wisconsin a stand of jack pine, periodically thinned, yielded 10 times as much usable wood as a comparable unthinned stand, largely because in the latter much wood was lost through the death of overcrowded trees. After thinning, a hardwood stand in the Northeast grew twice as fast as a nearby untreated stand; furthermore the new growth in the thinned stand was in choice trees, while in the other it was partly in trees of poor form and vigor. In the southern Appalachians, improvement cuttings—removing as much as half the timber in run-down oak stands—so stimulated the growth of trees chosen to remain that in 13 years the original volume was regained.

Light, frequent cuttings induce natural reproduction of shade-enduring tree species. For instance, studies show that sugar maple and beech seedlings that start in the shade of northern hardwoods develop quickly following light cuttings; that seedlings of red spruce and balsam fir become established, and that acorns sprout and young oaks thrive best under an overstory.

On the other hand, natural reproduction of light-demanding species—notably the pines, Douglas-fir, and yellow poplar—requires heavy cuttings. Studies in the Pacific Northwest indicate that seedlings of Douglas-fir will not thrive in less than 50 percent of full overhead light; clear cutting in mixed hardwoods in the southern Appalachians resulted in the establishment of twice as many yellow

poplar and birch seedlings as did partial cutting; and in Arkansas, 3-year-old seedlings of loblolly pine were four times as tall in openings one-tenth of an acre and larger, as under the shade of parent trees.

With timberland owners, seeing is believing. Demonstration areas where forests are yielding a steady profitable income soon become centers for the spread of good forest-management practices. It is so in Upper Michigan, where on the Dukes Experimental Forest partial cutting for the past 20 years has improved and regenerated northern hardwood stands, furnishing all the while a steady income from the products cut. Timberland owners in the vicinity, including some of the largest lumber companies in the State, are following suit. It is true also in the South, where timber owners throughout the pine belt have been influenced by the demonstrations on the Crossett Experimental Forest in Arkansas and the Olustee Experimental Forest in Florida.

A Nation-wide system of such experimental centers is the present aim of forest management research. Congress made an appropriation for beginning such a program during the fiscal year 1946.

Research Increases Yield of Naval Stores.—Research at the Olustee Experimental Forest on chemical stimulation of the flow of gum enabled the naval stores industry to increase the seasonal production of gum per laborer as much as 90 percent. Not only did this help the industry meet wartime demands in the face of a serious labor shortage, but also the lowered costs of production will be of great advantage in meeting competition from mineral substitutes.

The increased production comes from the application of sulphuric acid to the turpentine faces. Used with the conventional $\frac{1}{2}$ -inch deep chipping, acid treatment induces a substantial increase in gum flow, but it gives highest yields when chipping extends through the bark but not into the wood.

War Threw Spotlight on Forest-Products Research.—The war focused attention on technological progress in forest-products research. Many new products and processes, developed to meet war needs, hold promise of creating new industries and providing increased employment when directed toward peacetime uses.

A few highlights from the wartime work of the Forest Products laboratory at Madison, Wis., will illustrate the possibilities.

Methods of using low-temperature glues to laminate timbers for boats, and to fabricate planking and other items for outdoor use, have been worked out in collaboration with two pilot plants and other manufacturers.

Preservative treatment developed for the protection of plywood sliders in the tropics will have commercial significance.

Fibrous wood products with high acid-absorbent properties are proving satisfactory in the manufacture of rechargeable flashlight batteries.

A new process for making a hardboard from acid-hydrolyzed chips of either hardwood or softwoods was developed. The possibility of integrating hardboard production by this process with wood-sugar production is being explored. A good board has been made from

the residue after hydrolizing Douglas-fir chips enough to give 20 gallons of alcohol per ton of wood.

Work done at the Laboratory in solving the packaging and container problems for Army Ordnance and Army Air Forces is a highlight of war work that will carry over into peacetime utility. The training of some 14,000 persons in packaging principles and technique since 1942 will mean that the efficient use of packaging materials, economy of space, and protection of contents dictated by the urgency of war, will be widely available for commercial application. During the past year, special attention in the packaging field was given to testing in Panama the performance of materials and containers designed for moisture resistance under tropical conditions.

In order to facilitate and speed up the application of forest-product research, two forest-utilization units, each consisting of a small corps of experts, were established during the year, one in the South and the other in the Northeast. These units bring the findings of research to industry, assist in commercial application of new discoveries, and promote better forest utilization in other ways, transmitting local problems to the Laboratory for solution where necessary. The need for this kind of service is so widespread that five additional units will be established this year.

Forest-Resource Investigations Guide Forest Policy.—A program for making the Nation's forests contribute to national welfare and full employment must be based on reliable information on our forest resources and sound interpretation of their economic settings. To this end the Forest Service conducts a Nation-wide forest survey and a number of allied economic investigations.

The original survey of forest resources has been completed for about half the forest area of the United States. Some 320 million acres, chiefly in the Northeast, the Central States, and the Southwest remain to be covered. Furthermore, the information for the areas surveyed in the past must be brought up to date and kept current. Improvement of our forest-resource information is a continuing and indispensable job.

It is desirable periodically to make a comprehensive review of the entire forest situation in order to appraise the condition of the resource and its management in terms of present and future needs. Such a reappraisal is now being made. Based on forest survey data and on new studies, this reappraisal will cover the quantity, quality, distribution, growth, and drain of the forest resources in the various regions. It will reconsider future requirements and give special attention to the adequacy of the available stand in each region to sustain the current output of forest products and meet future production goals. The character of forest practices during the war years, and the extent to which forest lands are now under various degrees of forest management, are also being examined. The reappraisal project will also consider various physical, economic, and social aspects of the forest situation that have a bearing on forest depletion, forest employment, progress in good forest management, and public forest policy.

Our Range Resource and National Livestock Production

Meat, Hides, and Wool Are Needed in Reconstruction

Today, food is of paramount importance. Displaced people, damaged fields, disrupted communications, lack of work stock, inadequate shipping, enfeebled labor, and other factors resulting from the war have so reduced normal food production in many countries as to require outside assistance to prevent widespread starvation. Clothing is also urgently needed. Meat, hides, wool and animal byproducts from cattle and sheep raised in the range territory of our West and South will be a material factor in the assistance that can be offered by the United States.

Ability of the United States to meet such pressing needs for livestock products, in addition to her domestic requirements, depends greatly on the production of the 17 States of the Great Plains and far West, and 9 States of the southern pine region. These States produced 60 percent of the Nation's cattle and calves, 74 percent of the sheep and lambs, and 82 percent of the shorn wool in 1944.

Fortunately we are in position to meet the extraordinary demands for livestock products this year. The number of livestock in the 26 major range States is 23 percent greater than in 1939. Our ranges, especially in the West, are generally heavily stocked and some are seriously overgrazed. They are not in condition to sustain the present number of livestock. Many ranchers have had to reduce herds because of inadequate forage.

Marketing of cattle during 1944 was at an all-time peak. Yet there are 1,228,000 more cattle this year in the Western States than in 1934, when drought necessitated purchase of over 7 million head by the Federal Government to cut starvation losses and avoid ruin of thousands of producers.

The recent increase in livestock numbers followed recovery of the severely deteriorated ranges of the Plains in a period of favorable rainfall. Bumper hay, pasture, and grain crops, produced on farm lands, also helped to carry the record number of livestock during the war. But the situation is fraught with danger. The number of livestock using the range should be reduced to forestall in part the losses which another drought would entail and to safeguard the range itself.

Stockmen deserve great credit for their wartime production. But now they must look more closely at their individual range and livestock situations in order to make sure that there is a proper balance between forage, feed supplies, and livestock numbers.

Sustained Livestock Production Depends on Better Range Management

With a continuing heavy demand for meat, hides, and other animal products, we must offset the necessary reduction in livestock numbers by increasing production per head and by improving the productivity of the range.

Our research has shown that production per head can be increased and costs materially lowered by proper stocking and other improved

range management practices. Range improvements and heavier and better quality slaughter animals are obtained when the palatable forage plants grow and reproduce with full vigor. For example, at the Desert Experimental Range in western Utah, a well-managed, moderately stocked winter sheep range yielded $2\frac{1}{2}$ to 3 times as much forage over a period of 8 years as a comparable heavily stocked range. Sheep grazed on the moderately stocked range produced fully a pound more wool per head annually and were 12 to 20 pounds heavier than those grazed on heavily stocked range. Death of sheep from malnutrition was practically eliminated on the well-managed range, whereas 3- to 5-percent losses were experienced year after year on the other range. Lamb crops were 8 to 12 percent higher. Financial returns were \$1 to \$1.50 more per ewe annually.

Evidence of the inadvisability of the prevalent heavy stocking of cattle ranges has been accumulated on the Central Plains Experimental Range in Colorado. Cooperative studies there show that cattle grazing on short-grass ranges, stocked at the rate of 40 head per section during the 6 months of the 1944 summer grazing season, gained 319 pounds per head. In contrast, cattle grazing on comparable ranges stocked at the rate of 60 head per section for the same period, gained only 204 pounds per head. The heavy stocking damaged the range and the meat produced cost more.

In the 11 Western States, range livestock production is characterized by complementary use of public and private range lands. National forest ranges in the mountains provide most of the summer grazing. During this period, hay and other stored feeds are being produced on farms. Public ranges at lower altitudes also provide much of the winter grazing. Livestock are maintained most economically by correlating these seasonal grazing periods on public lands with grazing and feeding on private ranges, irrigated pastures, and in feed lots. Because seasonal use is so important, control of the number of livestock permitted on the public range exerts a powerful influence on the entire livestock industry of the West.

Proper correlation of grazing and timber growing on forest ranges will also help sustain livestock production. The higher value of timbered areas for grazing is indicated by studies in the mountains of California, where cattle grazed on ponderosa pine-bunchgrass range showed an average net gain for a 5-month grazing season of 205 pounds, while cattle on an adjacent mountain meadow range came off with a net gain of only 186 pounds. Maximum gains were essentially the same on both ranges, but the cattle on the meadow reached a peak weight earlier and then lost more weight in the fall.

Increasing Range Forage Production

Reseeding.—During the past decade, research, supplemented by extensive field trials, has established reseeding as a practical method of restoring several types of depleted range lands.

The reseeding of nearly 300,000 acres of spring-fall range on private lands in the Intermountain Region in the last 3 years supplies forage for more than 100,000 cattle (or 500,000 sheep) for about 2 months in the critical spring period. Cows and their calves from these reseeded ranges go to summer ranges in much better condition. These

reseeded areas also provide better conditions for lambing, producing greater lamb crops and reducing ewe losses.

The 1,250,000 acres of range reseeded in Montana during the past decade has a grazing capacity at least 10 times greater, and can carry from 60,000 to 80,000 more cattle, than before reseeding. This increased forage has added nearly \$500,000 annually to the income of Montana stockmen.

Not only does reseeding increase forage production, but the high quality of the forage results in more economical livestock gains. In cooperative studies at the United States Range Livestock Experiment Station in eastern Montana, yearling steers gained an average of 1.6 pounds per day during the spring and summer. Similarly, ewes and young lambs, grazed for a month in the spring on crested wheatgrass range in central Utah, gained over 12 pounds each. The cost of grazing the crested wheatgrass averaged only 7 cents for each ewe and her lamb per month, against 15 cents for grazing on rye pasture, and 45 cents for farm feeding of alfalfa hay and barley during the same period.

Converting Sagebrush to Grassland.—Practical means of converting low-value sagebrush range to grassland will also increase our range capacity. Methods such as raiing, harrowing with a self-clearing harrow, and breaking down the sagebrush with road rippers and spiked rollers kill a high proportion of the sagebrush and permit natural regeneration of the palatable forage grasses. However, reseeding, following the use of a heavy disk (Wheatland) plow, has proven best on ranges that are not too rocky. Wheatland plowing kills 80 to 95 percent of old sagebrush stands.

On relatively level sagebrush areas where desirable perennial grasses are already established, carefully controlled fire may be used. Soil moisture conditions must be favorable and all livestock must be excluded for a year. Fire is effective because sagebrush does not sprout when burned.

Sagebrush removal and reseeding increases grazing capacity 5 to 20 times, and raises the value of the land from less than \$1 per acre to \$10 to \$12 per acre.

Grazing on the National Forests

To overcome the adverse effects of severe overstocking of national-forest ranges during the first world war, reductions in stocking of about 45 percent have been made since 1918. Despite these heavy reductions, recurrent and prolonged droughts and other adverse factors have hampered progress toward correcting soil erosion and other unsatisfactory conditions and placing all national-forest ranges on a sustained-production basis. As a result, the Forest Service is still faced with a serious range problem. In many places, further drastic adjustments, sometimes involving complete exclusion of livestock, will be necessary. During 1944, paid permits were issued to 23,352 owners in and near the national forests to graze 1,225,000 cattle and horses and 280,000 sheep and goats.

In the western national forests 85,400 acres of range land has been reseeded since 1933. An additional 45,100 acres of pastured land was planted under the Civilian Conservation Corps program in eastern

national forests. The 130,500 acres reseeded to date is but a start on the rehabilitation of 4,200,000 acres that need reseeding.

On many areas in the western national forests the water supply is insufficient for the number of livestock that the forage will support. On other areas, the water supply is not permanent, so that the stock must be removed before the forage is properly utilized. Still other areas are rendered practically worthless for livestock grazing because of absence of water except at intervals during the winter. Poorly watered ranges are characterized either by overgrazing near water, unused forage far from water, or both. Water development leads to better distribution of livestock and more efficient use of the range, but this does not necessarily mean that more livestock can be grazed on a given area. To date, over 14,000 range-water developments have been constructed on the national forests. Many more are needed.

Wildlife and Recreation—Important Assets of the Nation's Forests

An important aspect of the prosperity which full employment will bring is a great increase in forest recreation. When pay envelopes are full and people are prosperous, they take more time for hunting and fishing trips and other vacation travel. Larger expenditures for outdoor recreation will be an important factor in the active use of income that is necessary to maintain full employment. Before the war, vacation and pleasure travel was edging toward second place in the Nation's industries—between 4 and 5 billion dollars was expended for that purpose annually. Much of this was undoubtedly related directly to the use of our forests.

Industries employing hundreds of thousands of people benefit by such expenditures stemming in part from use of forest land. Many business enterprises—vacation resorts, dude ranches, guiding, and taxidermy—depend almost entirely on the forest and its wildlife. Indirect benefits accrue to the transportation, food, clothing, fur, fire-arm, ammunition, sporting goods, automobile, petroleum, publishing, and many other industries. The fresh reserves of health, strength, and inspiration that people gain from hunting, fishing, and other outdoor recreation is of even greater value to the Nation than the monetary income to American business. An appreciation of the importance of outdoor recreation in an economy of abundance gives new meaning to the protection, improvement, use, and extension of public forests.

The National Forests Are the People's Playgrounds

The recreational assets of the national forests are available to people in all walks of life, while forest lands, streams and lake shores in private ownership are often closed to public recreation.

To preserve and enhance the natural assets of the national forests, simple facilities for camping and picnicking have been installed. In some localities individuals may obtain permits to construct their own cabins in the forests; resorts and hotels, built principally by private capital, offer vacations to those not desirous of camping out or erecting a cabin. Swimming areas and bathing beaches have been developed through the improvement of natural lakes and streams and construction of dams. Winter sports make national-forest recreation a year-round activity.

Recreational improvements and developments on the national forests are designed to meet public needs without lessening the values which make the natural setting desirable. Overuse of recreational areas is avoided. Particular attention is given to facilities that are attractive to those who can enjoy forest recreation only if the cost is small. Thus, emphasis is placed on picnicking, camping, and organization facilities. In this, the Forest Service cooperates with public and private organizations sponsoring forest vacations for the underprivileged, particularly children. Restrictions on the use of recreational facilities are kept to the minimum necessary for safety and sanitation. Exclusive occupancy of any area is granted only after ample provision has been made for present and prospective public needs.

A steady increase in recreational use of the national forests, stimulated first by low-priced automobiles and then by improvements constructed by the Civilian Conservation Corps, raised the number of visits to the forests to over 18 million in 1941. The war interrupted this trend. Visits dropped to 6½ million in 1943; but the pendulum is swinging the other way; 7½ million visits were reported in 1944. Now that gasoline, tires, and new automobiles are becoming available, more people than ever before will seek vacations in the forests. The need for picnic areas, camp grounds and organization camps will be far greater than can be served by existing facilities. Plans are being laid for a large program of construction and development. Meeting this need in itself will provide employment in all forest regions.

Wildlife in the National Forests

Wildlife is a major recreational attraction of the national forests, which contain about one-third of all the big game animals in the United States. In 1944 their big game population was estimated at over 2¼ million, of which almost 2 million were deer.

When the national forests in the West were first established, wildlife had been rather generally depleted. Since then, range forage has been restored and the wildlife habitat appreciably improved by timber cutting. The dense, unbroken forest formerly furnished little besides shelter. Areas opened up by cutting now furnish good browse and other requisites for wildlife.

Such improvements in natural conditions, coupled with years of protection under State laws, have brought big game to a point where skilled management is necessary to keep the number of animals in line with the capacity of the forest to support them—and to correlate wildlife with other economic and social uses of the land. A desirable balance can only be maintained when regulations to protect wildlife are supplemented by measures to utilize the annual increment of animals and to improve the forage crop.

Competition with livestock for forage is serious in some localities. Continued increase in big game, while permits for livestock are being reduced, is bound to bring dissatisfaction in the livestock industry. Yet reluctance of the States to liberalize restrictions on the killing of deer and other big game sometimes makes it difficult to effect necessary adjustments. Some progress, however, is being made in solving this problem.

For example, competition for forage formerly existing between elk and livestock on the national forests of Montana bordering on Yellowstone Park has been solved through the efforts of local committees, including influential citizens, the Dude Ranchers' Association, the Montana Fish and Game Commission, and the Forest Service. These committees inspect the range twice a year and then recommend an appropriate hunting season and the desired kill.

Elk and deer, the chief species on the national forests, have shown a net annual increase since 1921 of 8 and 13 percent, respectively. Hunters could take four times as many deer as at present without depleting the herds, if predator, winter kill, and other losses could be stopped. To prevent losses from starvation, and to hold damaging populations in check, often presents a complicated problem.

In an attempt to manage the Utah deer herds, an Interagency Committee has been set up consisting of one member each from the Utah State Fish and Game Commission, the Grazing Service of the Department of the Interior, and the Forest Service. This committee will inspect the ranges, determine forage conditions, agree on game-carrying capacities, confer with interested groups and persons, and prepare plans for the management of each natural big game unit. Such action should check overuse of the forage, and bring the game into adjustment with the dependent resource.

For other classes of wildlife, management must also be based on an adequate consideration of the ecological factors affecting both the animals and the habitat, rather than hunting seasons and bag limits. Fur bearers deserve special consideration. Beaver, for example, which have increased rapidly in some localities through protection and restoration methods, are now badly in need of management predicated on a sustained harvest of fur.

Forests and Water

Forest Influences Are Well Recognized

For nearly two centuries European foresters have recognized the close relation between forests and water. In headwater forests they subordinated the production of timber and forage to water control. They developed a type of forestry that protected headwater areas against erosion, that helped to prevent the formation of floods, and that furnished desirable conditions of water flow for many purposes. Early observations that a good watershed cover maintained desirable flow, whereas a poor cover resulted in irregular flow and water laden with sediment, were strengthened and clarified as time went on.

In this country, recurrent floods and more intensive development of water resources focus attention more and more on conditions on the headwaters of our streams. Watershed surveys by the Department of Agriculture have repeatedly disclosed that damaging floods and harmful sedimentation of reservoirs and stream channels had resulted from the abuse of watershed lands. Water engineers realize, as never before, that when the headwaters are well forested, the streams are capable of greater development and wider use than would otherwise be the case. Watershed management has a direct bearing upon the employment that can be created by river development.

Evidence is accumulating to show that management of the forest with the water resource in mind may, under some conditions, increase the yield of water for irrigation, industry, and domestic use. For example, proper cutting of a hundred acres of mature lodgepole pine in the Rocky Mountains may provide enough supplemental water to irrigate an equal area of agricultural land in the valley below.

Watershed Protection a Primary Objective in National-Forest Management

As a general rule, desirable watershed conditions are promoted by good practices in timber production, good range management, adequate protection of road banks, maintenance of an environment favorable for wildlife, and special protection for areas of outstanding scenic value. Thus, the objectives of watershed management are largely served by measures aimed at the conservation and development of other resources and services of the forest. However, in some areas special measures, over and above those required for the other resources, are necessary.

Plans for the protection and management of the national forests give primary consideration to the water resources. Thus, in southern California much more intensive fire protection is given to the chaparral lands than to many timbered areas because of the very high value of water in that region. Again, in some of the national forests of the Intermountain region almost complete exclusion of livestock is necessary, because depletion of watershed cover has gone so far that flooding and sedimentation are causing serious damage to irrigated valley lands.

In order to bring about optimum conditions on national forest watersheds, our development program envisages the expenditure of substantial sums for reforestation of old burns, restoration of depleted ranges, the stabilization of road banks, and the construction of engineering devices to supplement the beneficial effects of vegetation.

Watershed Research Should Be Expanded

Effective control of our water resources must be based on research. Following earlier sporadic efforts, comprehensive research on the influence of forests upon water got under way in 1930. In that year, studies were undertaken in six regions where water and related problems were recognized as of major importance. However, as a result of the war and other factors, funds for this work were cut 85 percent. Thus, for several years it has only been possible to maintain the most essential records on some of the more important experimental forests. Work at one experimental area, the Iron Fork in Arkansas, was discontinued entirely, and only with the aid of the Civilian Public Service Camp at Glendora, Calif., was research at the San Dimas Experimental Forest kept alive.

Our research has indicated opportunities for stabilizing stream flow, reducing flood and sedimentation damage, and improving methods of land management in order to provide greater service to the growing number of water users. During the last year, Congress indicated a desire to give this activity a more prominent place in American forestry.

Forest-fire Protection

Before the great natural capacity of our forest lands to serve human needs can be fully realized, the prevention and control of forest fire is everywhere essential. Unless we can cope with fire, employment based on the forest resources may only be viewed as transient. The history of organized forest-fire control is a record of continuing progress since the pioneering stage, 40 years ago. Yet much remains to be done. As time goes on, new problems arise; and fire liabilities accompany every new development in the public use of the forest. Forest-fire-fighting organizations, and the methods and facilities employed, cannot remain static.

Federal participation in forest-fire protection takes two forms. First is the huge task of providing protection for the 179 million acres of national-forest land, including much of the least accessible, roughest, and most difficult country in the United States. The second involves financial cooperation with the States in the protection of the much larger area of State and private lands outside the national forests.

Protection of the National Forests

Losses Reduced, But Costs Increase.—In 1944, the Forest Service faced many difficulties in its efforts to protect the national forests from fire. Among these were the further loss of experienced and capable fieldmen, the shortage of labor for fire fighting and slash burning, and the increasing obsolescence of all heavy fire-fighting equipment, with no replacements possible. Inflammable logging slash accumulated on thousands of acres.

Splendid cooperation was obtained from many public-spirited citizens and public and private agencies. Many worked wholeheartedly in the Wartime Forest Fire Prevention Campaign. Others assisted in the reporting and suppression of fires. In the West, more than 70 women successfully filled important jobs, such as lookouts, dispatchers, telephone operators, patrolmen, and tank-truck drivers.

The Armed Forces provided the greatest single insurance against major fire losses. They contributed approximately 60,000 man-days of fire-control help.

The success attained in protection of the national forests is reflected by the following summary (table 1):

TABLE 1.—1944 Fire Record in the National Forests

Item	1944 (Calendar year)	1940-44 (5-year average)
Total fires.....number.....	10, 847	12, 70
Total man-caused only.....do.....	5, 842	6, 99
National-forest land burned.....acres.....	208, 918	244, 91

Although number of fires and acreage burned were lower than the 5-year average, fire-control costs were substantially higher. A major factor in this rise in fire-control costs was the increases of 20 to 10 percent in wages paid to guards and fire fighters.

Almost one-third of all fire-fighting expense on the national forests during 1944 was incurred in California during a 3-week period of extreme fire danger. Some of the fires made runs of from 3 to 7 miles during their first afternoon. Many originated outside the national forests. The Southwest, the Lake States, and the deep South had summer droughts that made it necessary to keep the protection force on the job longer than usual. But in the Northwest the summer fire season was generally favorable.

Late in the fall of 1944 a new threat developed. Scores of Japanese super balloons, bearing incendiary bombs and carried eastward by high-altitude air currents, began to arrive from across the Pacific. This threat was met in 1945 by expanding the regular "smoke jumper" organization and by the cooperative loan of paratroopers, ground forces and aerial reconnaissance by the Army. Fortunately, most of the balloons arrived during low-hazard periods. They caused no fires of consequence.

Use of Airplanes in Fire-control Work.—Aerial methods of speeding up the attack on forest fires in remote areas made considerable gains during the year. The smokejumper organization, recruited largely from Civilian Public Service camps and trained mostly at Missoula, Mont., was increased to 120 men in 1944. They made 526 parachute jumps to 180 forest fires far from roads in the mountains of the Northwest. Aerial attack saved at least \$110,000 in fire-control costs. The plan of operation has proved both effective and economically sound. For this reason, the smokejumper force was again expanded and additional ground-fire positions were abandoned in 1945.

Cooperative Protection of State and Private Lands

The area of State and private forest land that warrants Federal aid in organized protection is estimated at 431 million acres. In general, this includes the most accessible and best timber-growing lands in the country. During the calendar year 1944 organized protection was provided for some 297 million acres. Yet almost one-third of the private forest land in need of protection is still without it. Most of this is in the South.

For the fiscal year 1945, Congress increased the appropriation under the Clarke-McNary law for cooperative protection of State and private forest land to \$5,300,000. This assistance is contingent upon the matching of Federal funds by State and private expenditures. In addition, \$1,000,000 was authorized for special protection of areas of tactical military importance without requiring matching by the States and private owners.

Over 14½ million dollars was spent for regular cooperative fire protection during the fiscal year 1945. The Federal Government contributed over 40 percent or 5.9 million dollars. State expenditures amounted to 6.5 million dollars and private owners added 2.1 million. Over 56,000 fires were reported on protected areas—29 percent less than in 1943. The area burned (estimated at 2.3 million acres) and the damage (placed at 7.1 million dollars) were also substantially less than in 1943. While this improvement doubtless reflects more ef-

fective organization, the record was helped by unusually favorable climatic conditions in the South.

As would be expected, the largest fire losses occurred on the unprotected areas, yet even here the number of fires and area burned in 1944 were only about half of what they were in 1943. Crude estimates, not complete for all States, place the number of fires on unprotected land in 1944 at 66,000, and the area burned at 13.9 million acres.

The use of trained and well-equipped stand-by crews, strategically located so as to reach and suppress fires promptly, was effective in preventing destruction of military installations in forested areas, in reducing losses and the disruption of the output of forest products needed for war, and in lessening the diversion of soldiers, war workers, and farmers from essential and productive work to fire fighting.

Research Improves Fire-Protection Techniques

Paralleling the improvement of forest-fire-protection facilities and organization, a continuous program of research has provided the ground work for technical progress in fire fighting, preparation for fire fighting, and reduction of fire hazard.

Methods of rating forest-fire danger developed by the Forest Service have proved their worth in the intensified protection program necessitated by the war. They are now employed by State, Federal, and private forest-fire protection agencies throughout the country. Danger rating has taken most of the guess out of fire-danger forecasting, and given a sound basis for estimating the probable size of the detection and suppression jobs.

The ratings are based on the measurement of such key factors as moisture of forest fuel, wind velocity, and past rainfall. Fire records for 2 years in the North Atlantic States show that on days of highest danger rating, 100 times as many fires occurred, 700 times as many man-hours were required for suppression, and 4,000 times as many acres were burned over, as on days of lowest rating.

Through research we are learning how prescribed burning can best be used to reduce dangerous accumulations of forest fuels. In the West, logging slash left after dense stands are cut jeopardizes large areas of timber; in the South, wild fires in dense growth of grass and brush may destroy valuable pine reproduction. Fire properly controlled can be an effective means of reducing such hazards. It may also be helpful in the establishment and early growth of certain valuable tree species.

In the Pacific Northwest, detailed observations were made last fall to determine the conditions of atmosphere, fuel, and topography, and the techniques of fire control that favor efficient burning of logging slash. In Florida, much was learned from experimentally burning 39,000 acres of the Osceola National Forest, on which a heavy rough of grass and brush had accumulated.

The question of how much we are justified in spending for fire protection in given areas and under given conditions has also been tackled. A study in the southern Piedmont of Virginia shows that, although fire losses are already fairly low, the sum of all costs and associated losses would be reduced to a minimum if protection expenditures were doubled. The average annual area burned would perhaps be cut almost in half.

Aside from these specific results, the study has developed methods for appraising flood, sedimentation, and erosion damages, and losses in yield of ground water attributable to fire. It has also worked out better methods for appraising damage to timber and wildlife values.

A similar study is nearing completion in the Pacific Northwest, and two additional areas are under investigation in the East, one in the mountains of southwestern Virginia, and the other in the South Carolina Coastal Plain.

War Activities

In addition to our contributions to the war effort described in other sections of this report, the Forest Service participated in a number of special war activities.

Timber Production War Project

At the request of the War Production Board, the Service continued to work with landowners and operators, chiefly in the East, to facilitate and stimulate the output of forest products for war. State and other local forestry agencies cooperated in a substantial way.

Much attention was given to the manpower problem. In one State, for example, every farm woodland owner was contacted in order to explain the urgent need for forest products. In another State, a production goal was established in each county. In a third, log-buying stations were set up to provide local markets for timber from nearby woodlands. In still another, special recruiting drives were made after actual labor needs were determined by visiting the logging camps.

Loggers and sawmill operators on the one hand, and local draft boards on the other, were helped in the handling of deferments for thousands of workers. Short cuts were developed to simplify the release of deferred farm workers to forest-industry jobs. Safety instruction and job training, organized for 18,300 prisoners of war, helped to double the average daily output of prisoners employed by the forest industries. Absenteeism was attacked by having wounded veterans give talks and show exhibits of the use of wood in war at sawmills and logging camps.

Operators were also helped in obtaining supplies and equipment. The use of bow saws, power saws, improved loaders, log turners and other labor-saving equipment was encouraged, with outstanding results. Sawmill specialists helped small-mill operators to increase the quantity and quality of their output. Almost invariably there were more requests for this service than could be handled.

The supply of stumpage was augmented by seeking out suitable stands of timber and persuading the owners to sell. Many owners who feared that commercial cutting would ruin the appearance and condition of their land were willing to sell when our representatives insured the application of good forest practices. In many localities we were unable to handle all the requests for help in marking timber and supervising cutting.

Keeping Track of Forest-Products Needs and Output

The Forest Service continued to cooperate with the War Production Board and other war agencies in conducting surveys and rendering other technical assistance on problems relating to forest products

needed for the war effort. Quarterly reports on factors affecting lumber production helped in the handling of major policy questions. Periodic field surveys supplied information on production, stocks on hand, manpower, and equipment needs. Price orders were analyzed to gauge their probable effect on production. Problems in the production of many special items made from wood were investigated. We were repeatedly called upon by war agencies to furnish information on the supply of standing timber—particularly the most critical species—and on the quantity being cut by species and grades.

Texas Timber Salvage

During the year, the Forest Service wound up the project it had undertaken—with the financial assistance of the Defense Supplies Corporation and the Disaster Loan Corporation—to make timber in eastern Texas, damaged by a severe ice storm early in 1944, available for war use. In order to avoid loss, the damaged trees had to be harvested promptly. The job was much greater than local industries could handle alone.

When Forest Service salvage operations were halted in January 1945, some 80,000 cords of pulpwood and 11,000,000 board feet of sawlogs, in addition to what the local industries salvaged themselves, had been made available for war needs. Most of this came from national-forest land. Deterioration of the damaged timber made further salvage impractical. Almost all the Government salvage work was done by prisoners of war.

Emergency Rubber Project

The Emergency Rubber Project was limited in 1945 to the maintenance of 31,000 acres of guayule plantations; carrying on essential research; construction and operation of one new mill; operation of the old Salinas mill; and a start toward complete liquidation of the nurseries.

Several labor camps, used by the Army as Good Conduct Camps for war prisoners, assured the Project a supply of economical and satisfactory labor. Some of the shrub from the first plantings was processed for rubber. A review of irrigation practices in the plantations led to drastic cuts in the use of water which, it is believed, will result in a higher yield of rubber as well as in reduced costs.

After a series of investigations, the War Production Board asked the Rubber Reserve Company to erect four new mills so that all the guayule plantations could be milled out within the two years, but this plan was abandoned when the war ended.

Cooperation with guayule producers in Mexico both in processing and agronomic research was accelerated. About 20 million seedlings were sold to the Continental-Mexican Rubber Company for planting in Mexico, and results of the guayule milling techniques have been made available to the Mexican Government.

A sale of about 20,000 pounds of guayule seed to Argentina was consummated, half of it for immediate shipment.

General and technical information has been exchanged with members of the USSR Rubber Mission to the United States on both guayule and kok-saghyz.

War Mapping

Last year, the War Department terminated the topographic mapping on which the Forest Service had been engaged. However, the Navy Department requested similar assistance and, when the war with Japan was speeded up, a large increase in personnel was required.

The job involved making maps of war areas with as much accuracy as possible from whatever information was available. Sometimes, there were no maps at all; in other instances recent aerial photographs permitted changes on existing maps. Ordinarily, the source material would not be considered sufficiently accurate or adequate for good mapping. Great ingenuity was called for in finding practicable and satisfactory ways of using available data. The morale of the organization was high; each man realized the importance of the work in the Pacific war.

Foreign Missions

Forest Service specialists have participated in several war and post-war missions in Europe. Members of the Forest Products Laboratory were sent to Paris to conduct training courses for Army officers and men charged with the packaging of vast quantities of war supplies for transshipment from Europe to the Pacific.

The Forest Service participated actively in an organization set-up to gather information on technical and industrial developments in Germany during the war years. Operating headquarters were established in London, with a staff of 2 administrators and 10 investigators.

German Industrial Disarmament Policy

At the request of the President, a number of committees were organized to formulate and recommend details of United States policy on the industrial disarmament of Germany. The Chief of the Forest Service was chairman of a committee made up of representatives of 8 interested departments and agencies covering the field of forests and forest products. Forest Service personnel did much of the research and related work to help this committee decide on recommendations on the treatment of Germany's forest resources and forest products industries.

International Collaboration in Forestry

The Constitution of the United Nations Food and Agriculture Organization (FAO) provides that forestry and primary forest products shall be included in the functions of the Organization. Early in 1944, the Interim Commission set up a technical committee to recommend action by FAO in forestry and forest products. Dr. Henry S. Graves, Dean Emeritus of the Yale School of Forestry, and Chief of the Forest Service from 1910 to 1920, was chairman, and the present Chief served as a member of the Committee. Other members included men from a dozen countries, acting in their personal capacities, rather than as representatives of governments. The Forest Service supplied technical experts.

The forestry committee's report was submitted to the Governments of the United Nations in April 1945. It points out the importance of forests and forest products in the world economy and world agriculture, outlines past attempts at international cooperation, discusses

the forestry problems on which international action is needed, and indicates the forestry fields in which the Committee believes FAO should operate.

The People of the Forest Service

"Of far greater importance to officers than the material or tools committed to their charge is the personnel with which they are concerned." This appraisal of the importance of personnel applies as well to the Forest Service as it does to the Navy, in which it originated. The Forest Service has always believed that it must have good men—men to work, men to study and plan, and men to lead the fight for an adequate forestry program in this country.

During the war period, 1,825 men and women in the Forest Service left their regular jobs to serve in the military forces. At the close of the fiscal year, 83 of these had returned to their old jobs and 16 were killed in action. Service in uniform, however, is only part of the contribution made by Forest Service personnel to the war effort. At the outbreak of war, our regular program was largely reoriented so as to increase the production and facilitate the use of forest products for military needs. In addition, a number of special projects were undertaken, largely in cooperation with the Army and Navy and various civilian war agencies. Our people met these war demands with enthusiasm and determination. I want to express my personal appreciation of the faithful, loyal, self-sacrificing service of all our employees that enabled us to make a contribution of which we can be proud.

I also want to pay tribute to the 83 men and women who retired from active duty during the past year. The average age of these people was 63 years and the average period of their service 32 years. Many of them had been in the Forest Service since its organization, 40 years ago. These pioneers worked with Gifford Pinchot, our first chief, to establish the fundamental policies which have guided the Forest Service throughout its history.

In the past 40 years the Forest Service has had a significant record of achievement. It spearheaded the conservation movement in America. The national forests under its jurisdiction have become the world's outstanding public-forest system. It has developed sound forestry techniques applicable to American conditions. Wherever the practice of forestry has been adopted by timberland owners, it can usually be said to reflect in some degree, whether directly or indirectly, the pioneering work of the Department's foresters.

But the biggest jobs remain. The downward trend of our forest resource has yet to be reversed. The bulk of our forest lands are still handled with little regard for future productivity. Large areas of depleted land must be restored. Few forest industries have an assured supply of timber for sustained operation. Forest employment rests on a precarious base.

On its fortieth anniversary, February 1, 1945, the Forest Service pledged itself to renewed effort in a program of forestry that will make the forests play their full part in serving the Nation's agriculture, industry, and people. Such a program will be a vital factor in meeting the most critical need our country faces in the years ahead—full employment.

Expenditures and Receipts

Revenue from the national forests during the fiscal year 1945 totaled \$16,047,935, of which \$4,038,840 was by law returned to the States.

Expenditures for the national forests aggregated \$27,262,158, of which \$5,768,158 was for forest roads and trails, and \$67,512 for acquisition of land. The balance, \$21,426,488, was for operation and protection.

Other Forest Service expenditures included cooperation with States and private agencies in fire control, planting and forest practice, \$6,771,316; contributions from outside sources for fire control, slash disposal, improvement work, etc., \$2,492,836; research \$2,271,096; general administrative expense \$624,894; and emergency rubber project \$3,779,440.

Services for other Government agencies involved expenditures of \$5,211,596, including \$1,775,233 for the War Production Board; \$1,077,034 for the Army; \$371,176 for the Navy; \$1,205,923 for the Public Roads Administration; \$327,839 for the Selective Service system; and \$454,391 for other agencies.

Total net expenditures were \$48,413,336. In addition, expenditures for which appropriations were reimbursed amounted to \$5,016,724, so that aggregate expenditures by the Forest Service for the fiscal year 1945 were \$53,430,060. These moneys were derived from and accounted for under 125 separate appropriation titles.

The Forest Service was also responsible for the Texas Timber Salvage Project, involving expenditure of \$709,306 made available by the Disaster Loan Corporation and the Naval Stores Conservation Program, involving payment of \$847,218 from funds of the Agricultural Adjustment Agency.

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REPORT OF THE
CHIEF OF THE FOREST SERVICE

1946
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*Timber Shortage or
Timber Abundance?*



UNITED STATES DEPARTMENT OF AGRICULTURE

U. S. DEPARTMENT OF AGRICULTURE,

FOREST SERVICE,

Washington, D. C., October 15, 1945.

HON. CLINTON P. ANDERSON,

Secretary of Agriculture.

DEAR MR. SECRETARY: In this, my first annual report to you, I want to emphasize the importance of forestry in our national goal of full employment for the future.

Perhaps the outstanding lesson of the war is that abundant resources are the essence of national security and strength. Just as truly, the measure of possible employment in peacetime depends on the abundance of our basic resources.

By building up the productivity of our forests and ranges and fully developing all uses of these natural resources we may ultimately create 2½ million permanent new jobs—jobs on the land, in business relating to forest recreation, in the industries processing forest and range products, and in the transportation of forest products and livestock.

This is the goal and the justification for the comprehensive forest program in which the Forest Service is engaged.

We cannot build up forest productivity so long as destructive cutting practices are prevalent. Nation-wide regulation of cutting and other forest practices would give assurance that our land would be kept reasonably productive and thus help sustain employment.

We must increase the acreage of public forests and greatly intensify public forest management.

We must encourage and assist private forest landowners and operators in good forest practices and in the marketing of their products. In expanding aid to small owners we should encourage the establishment of cooperative associations and take care of those who own forest land not in farms, as well as the farmers. We must intensify protection against fire, insects and disease; adjust taxation so as not to impose inequitable burdens on owners of young timber; make loans on terms adapted to the long-time nature of timber growing; and we must strengthen our forest and range research to increase forest and range productivity, eliminate waste, and enlarge the utility of wood.

All these things will help create and sustain future forest employment. But before our forests can make their full contribution to the national welfare we shall have to do a large volume of work on both public and private lands. Recent estimates envisage the expenditure of \$2,215,000,000 in a program of public forest work that would keep 163,000 men busy for about 6 years. This work is needed to restore depleted forests and ranges to reasonable productivity, to open up virgin timber for commercial use, to build the roads needed for sustained-yield forest management, to improve the growth of young timber, to provide adequate protection from fire, to develop water and other improvements that will facilitate good range management, to prepare for a greatly increased volume of recreational use, and to install structures that will check runoff, reduce erosion, and help prevent the formation of floods. An even larger number of men than suggested for the public works program could be used for additional work along these lines on private forest lands.

During the war years we have subordinated our long-term objectives to activities contributing to war production and military use of forest products. Now it is time to gear our program to the needs of an expanded peacetime economy.

Sincerely,

Lyle F. Watts

Chief, Forest Service.

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**REPORT OF THE
CHIEF OF THE FOREST SERVICE**

1946

**TIMBER SHORTAGE OR TIMBER
ABUNDANCE?**

WE ARE NOT GETTING ENOUGH TIMBER

Our forests today are not supplying enough timber products. While thousands search desperately for places to live, construction of urgently needed dwellings is hampered by lack of building materials. Lumber is perhaps the number one bottleneck. Plywood also is seriously short. Our special efforts to meet housing needs have caused restrictions on other essential uses of lumber—for business and industrial construction and repair, for farm buildings, for manufacturing numerous products, for boxes and crates to move commodities to consumers. We are now unable to meet world-wide needs for lumber exports. Pulp and paper are short, with demands mounting. Newsprint supplies are still restricted.

Manpower shortages and the shortage of operating equipment, supplies, and repair parts were major factors affecting lumber production during the war years. Some of these difficulties, together with labor unrest, continued to retard production in 1946.

These are temporary difficulties. It has become increasingly evident, however, that shortage of standing timber in many localities is a major deterrent to increased lumber production. And this is not a matter that can quickly be remedied. Long before the war, timber shortage had curtailed output in the older timber-producing regions—New England, Pennsylvania, and the Lake States. During 1946, shortages of pine timber big enough to make good lumber were pronounced in various parts of the South. Even in the West some localities are feeling the pinch; industry is reaching toward the more remote stands of timber, searching for new “logging chances.”

A rapidly growing pulp and paper industry is competing with lumber producers for available timber. Heavy demand for poles and piling likewise means competition for available timber, especially in the South.

The plain fact is that our supply of readily accessible, merchantable standing timber is running low. Sufficient manpower, equipment, and sawmill capacity no doubt will be available in the next few years for a much larger output of lumber, but the increasing scarcity of good timber will continue to limit the level of production.

The present shortage of timber products, therefore, will not be of short duration. It will last until we grow a great deal more saw timber, and you can't grow trees of saw-timber size overnight. We are becoming more and more dependent on the size of our annual timber crop. And our annual timber crop is not big enough to supply the Nation's present appetite for timber products. It is far short of what we are likely to need for a strong, expanding economy in the future.

For years, every annual report of the Forest Service has warned that we cannot continue to eat into our forest capital without serious consequences. The Forest Service does not wish, however, merely to say "I told you so." Rather, it would emphasize, with all the strength it can command, that we *can* grow the timber we need, and that it is high time we increased our efforts to do so.

WORLD FOREST SITUATION IS OF THE SAME COLOR

Timber shortage is general throughout most of the civilized world. The Technical Committee on Forestry of the United Nations Food and Agriculture Organization reports that—

In the face of * * * rapidly multiplying uses for wood which create ever-mounting wood needs, the world is confronted by the inescapable fact that the forests—sole source of wood—are steadily diminishing.

Over 60 percent of the softwood timber upon which the world depends for construction material is in North America and Europe. Of the once heavily forested continent of Europe, the report says, only three countries now have appreciable quantities of timber beyond their national needs. Life among the crowded millions in China and India is forced to adjust itself to the privations imposed by chronic wood starvation.

Today less than 15 percent of the world's timberlands are being handled as a renewable, continuously productive resource, the committee states. About two-thirds of the world's forests receive neither care nor protection.

We cannot look to foreign sources, therefore, to supply any substantial part of our lumber needs. Europe and Asia cannot meet their own. The undeveloped forest resources of the tropics may supply greater quantities of cabinet woods and specialty items, but they cannot take the place of the coniferous forest of the Temperate Zone. During the war years, Canada supplied us with about a billion board feet of lumber a year. We can expect little if any more in the postwar years. Canada, like the United States, faces a dwindling supply of accessible saw timber, and other nations besides us are clamoring for Canada's present exportable surplus.

Even now we are importing about a third of our pulp and paper, largely from Canada. We can look to some increase in the supply from our northern neighbor, but by and large any increase in our requirements for pulp and paper products will have to be met by our own production.

So, in large part, we shall have to grow our own. We would do well, moreover, to work for an annual timber crop large enough to provide liberally for domestic requirements, to increase the opportunity for healthy export trade, and to create reserves to draw on in time of need as a measure of national security.

In working for timber abundance, we shall at the same time be increasing the many other values and benefits that thriving, well cared for forests give. We shall be improving the protection of watersheds, safeguarding water supplies, reducing the menace of floods. We shall increase the opportunities for wholesome outdoor recreation; improve habitat for wildlife. We shall provide a better economic background for sound community development in forest regions. We shall restore scenic beauty to ugly areas of depletion, make our country a yet more pleasant one in which to live.

THE NATION'S TIMBER SUPPLY IS DWINDLING

During 1945-46 the Forest Service made a reappraisal of the Nation's forest resources in order to check up on current trends in the forest situation, evaluate progress, and provide an up-to-date factual basis for conservation objectives and policies. The results will be made available in detailed reports; only some of the high lights need be given here. They show plenty of cause for concern.

In 1909 the Bureau of Corporations estimated the total stand of saw timber in the United States at 2,826 billion board feet. The reappraisal estimate, as of 1945, is 1,601 billion board feet. This would indicate that in 36 years the Nation's wood pile has been reduced by 44 percent.

There is every reason to believe that the drop in volume of standing timber since 1909 is much greater than indicated. Many kinds of trees which were then considered of no value are now being used and are included in the 1945 estimate. Also much smaller trees are classed as saw timber these days, especially in the eastern half of the country. (Saw timber in the reappraisal estimate means all trees big enough to saw into lumber, whether used for that purpose or not.)

The reappraisal estimate of the Nation's saw-timber stand is 9 percent less than the estimate made by the Forest Service in 1938 for the Joint Congressional Committee on Forestry.

These over-all figures do not show the full picture as to character of timber, trends within States, or as to individual species of trees. More than half of the present total saw-timber stand is in what is left of our virgin forests; 96 percent of the virgin timber is in the Western States. But not all virgin timber is high-quality timber. Perhaps a third of it is of relatively low-value types, such as lodgepole pine.

The second-growth stands, upon which we are becoming more and more dependent, are not producing the quality and kinds of timber needed for many uses.

In Mississippi the saw-timber volume of all species has declined 15 percent since the middle '30's. But there has been a 32-percent decline in the volume of pine—the State's most important timber species. In northeast Mississippi, pine volume dropped 64 percent.

In New England and the Middle Atlantic States, high-grade white pine is practically a thing of the past. In the Lake States there is in sight at the present rate of drain only a 6- to 8-year supply of yellow birch suitable for the high-quality veneer so much in demand during the war. Indications are that there is not enough spruce in the Lake States to sustain the present demand for spruce pulpwood another 20

years. One Wisconsin pulp mill is bringing wood a thousand miles from the Rocky Mountains.

Hickory handle material is growing scarce in the Central States. Barrel makers are combing large areas for white oak stave material. The supply of white oak that will meet the requirements for ship timbers is already virtually exhausted.

In the South, stands of softwood trees that would yield large, heavy structural timbers are getting scarce. Several hardwood sawmills have closed because of the scarcity of quality logs.

The quality situation is beginning to tighten up in the West also. The supply of Sitka spruce suitable for aircraft use was inadequate to meet wartime needs. Competition is becoming more intense between plywood manufacturers and lumber mills for Douglas-fir logs of peeler grade.

Quality decline is noticeable not only in the growing scarcity of choice, sought after trees, but in the general deterioration of many timber stands. Long years of "creaming" the forests for desirable timber has resulted in reduction in the percent of valuable species, and a consequent increase in the proportion of low-value trees. Large areas in New England, for example, have been taken over by such inferior species as gray birch, aspen, and pin cherry, or highly defective trees of the better species. Clear-cutting the second-growth hardwood has resulted in stump-sprout stands of value only for fuel wood or other low-grade products.

Destructive logging and repeated burning since colonial times have reduced three-quarters of a million acres of oak-pine land in New Jersey to a virtually nonproductive status. Similar conditions in eastern Pennsylvania have converted large areas to scrub oak. Millions of acres of former pine lands in the Lake States now bear scrubby stands of aspen and oak. A considerable acreage in the Ohio Valley States is restocking to low-value sassafras and persimmon.

In the South, longleaf pine has been succeeded by scrub oak on more than 2 million acres. Inferior hackberry-elm-ash growth has replaced valuable oaks and sweetgum on 10 to 15 percent of the Mississippi Delta forest area. In the Piedmont of North Carolina, entire counties are now mostly covered with scrub hardwoods because the mills have virtually exhausted the pine timber and better hardwoods.

In the eastern half of the United States, there is a general downward trend in tree sizes. You can find mills cutting ridiculously small logs for lack of reasonably large timber. A survey of 118 plants in the Northeast showed that the average log size for 69 of these mills was 10 inches or less. A canvass of hardwood mills in the Mississippi Delta revealed that many plants are operating on logs one-half or one-third as large as formerly. With small trees it costs more to saw the same amount of lumber. And you get a poorer grade of material. You cannot get big, choice, wide boards from tiny trees.

PRESENT GROWTH vs. PRESENT DRAIN

In 1944 we took from our forests for lumber, fuel wood, pulpwood, and other products some 12.2 billion cubic feet of wood. To this must be added some 1.5 billion cubic feet lost as a result of fires, wind, and ice storms, and damage by insects and tree diseases. This makes a

total annual drain of 13.7 billion cubic feet. Against this drain, the amount of wood added to our timber stand each year by growth is estimated at 13.4 billion cubic feet. In this near-balance, we must remember, however, that much of the drain is of high-quality material, while the growth is generally of poorer quality.

But in trees of saw-timber size—and the bulk of our forest industry depends on saw timber—drain is at the rate of 53.9 billion board feet, while annual growth is only 35.3 billion board feet. Saw-timber drain thus exceeds growth by more than 50 percent.

We are overdrawing our saw-timber bank account by about 18.6 billion board feet a year.

We can reduce the drain from natural causes by tighter fire protection and by more intensive warfare against destructive insects and diseases. Common sense dictates that loss and waste from such causes be reduced to the minimum.

But about 90 percent of the total drain comes from cutting timber for use. And we are still not getting as much timber as we need. The answer obviously, for the long pull, is to grow more timber. Meanwhile, some drastic adjustments are inevitable.

If prevailing practices and present rate of cut region by region were to continue, we could look to a further reduction of some 27 percent in our timber resources in another 20 years. Moreover, intensified search for high-quality trees would lead to a significant reduction in average quality of the saw timber that remains.

In board-foot volume, the greatest reduction of saw-timber stand is taking place in the Pacific Northwest. A 40-percent decline in 20 years is in prospect here. This would mean a reduction in saw-timber stand from its present 630 billion feet to 383 billion.

Western forest industries grew up and still operate, in the main, on virgin timber. As new opportunities for operation in virgin stands play out, the West Coast States will be unable to maintain the present level of production. The West must look to its second growth for the future. There is danger that some of the second-growth stands in private ownership may be improperly and prematurely cut. This is already happening. An increasing number of small mills are stripping off the second growth, consuming the industry's future timber stocks.

The South has been optimistic about its timber future. But for the South as a whole, 20 years more of the present cut under prevailing practices would mean a reduction of one-third in the volume of saw-timber growing stock. For the Southeastern States alone, with drain currently 3½ billion feet annually in excess of growth, growing stock is on a decline that will, if continued, reduce the saw-timber stand about 60 percent in the next 20 years. Since the South now accounts for about 45 percent of our total lumber production, timber depletion in this region materially affects the national production outlook.

Other eastern regions, producing about 10 percent of the Nation's total lumber cut and 16 percent of the saw timber cut for all uses, have insufficient saw timber of suitable size and quality even to sustain present production levels much longer. Throughout these regions—New England, the Middle Atlantic, Central, and Lake States—the big problem is one of building up the forest capital, or growing stock. With

36 percent of the country's total commercial forest area, they are capable eventually of producing a much greater share of the Nation's annual saw-timber supply.

PREVAILING CUTTING PRACTICE IS STILL POOR

A field survey of prevailing methods of cutting was made for the first time as part of the reappraisal.

The analysis shows that a majority of large owners are doing a fair or better job. On nearly 30 percent of the operating forest land in industrial or other large private holdings cutting practice is good. But on the much larger area in small private holdings a high percentage of cutting practice is poor or destructive.

For all private forest land, cutting practice on 64 percent is classed as poor to destructive. Twenty-eight percent rates as fair; 7 percent as good. Only 1 percent is classed as of a high order.

Good cutting practice keeps the forest land continuously productive. It follows principles developed through years of research and experience in scientific forestry. It leaves the forest in condition to keep on yielding other and often better crops of timber.

Poor cutting practice strips the land of all present values without thought of the future. Or it mows down young stands prematurely, before they have reached the period of most productive growth. Or it high-grades the stand, taking out the best species and leaving a residue of poor, low-value trees. It is the type of cutting that has resulted in progressive deterioration of large areas of our forests.

"Fair" practice means that there will be some degree of restocking. But it will take "good" practice to build up an adequate growing stock. And to realize the maximum permanent values of forests will take practice of a high order.

The encouraging advances in good practice by industrial forest owners will not alone solve the problem of future national timber supply. Corporate and other large holdings represent only 15 percent of the total commercial forest acreage in private ownership. The other 85 percent is in medium-sized or small holdings; 40 percent is in farms.

It is on these forest lands in small tracts that the largest percentage of poor cutting prevails.

CAN WE SUSTAIN OUTPUT WITHOUT DETRIMENT TO FUTURE CROPS?

It will take real effort over a long period to put our forests in condition to grow as much as we are likely to need for the future. Meanwhile, we face several decades of limited supply.

Because of growing-stock shortages, it seems unlikely that the eastern regions can ward off for more than a few years a substantial decline of saw timber cut below present levels. We shall have to draw heavily on the West, therefore, to hold up our national timber output during the years it will take to rebuild eastern growing stocks. But we must guard against unnecessary local depletion which will not only work hardship on the communities concerned, but will also in-

crease the pressure on other regions. Light partial cutting should be applied wherever it can be used to obtain more saw-timber growth without waiting for new stands to grow from seed. With new access roads and utilization of less-favored species, some sections of the West may be able to increase output somewhat for three or four decades. However, after the remaining virgin stands have been worked over, output may be expected to drop even below present levels.

In all parts of the country crowded young stands should be thinned to obtain faster growth, and premature stripping of young timber should be prevented. By these and other measures to build up an adequate and well-balanced growing stock we can lessen the difficulties of a period of restricted supply and eventually achieve our long-term goal of timber abundance.

If we fail to do this, the period of inadequate supply will be prolonged indefinitely.

HOW THE NATIONAL FORESTS CAN HELP

The national forests include 73 million acres capable of growing commercial timber crops. They contain one-third of the national saw-timber stand. They are being managed for continuous timber production. In recent years they have supplied about 10 percent of the Nation's yearly lumber cut. With careful management of their timber resources, the national forests can help to cushion the shock of private timber exhaustion in many areas, and save many mill operations from shut-down. Eventually their total sustained-yield output of timber can be more than doubled.

New roads now under construction or planned will provide a means of reaching inaccessible timber stands in the national forests.

For the long pull, the national forests can do a special service in production of high-quality material. The long period needed to grow trees big enough to make large timbers or certain specialty materials discourages many private owners. Such trees must be held many years, during which they bring in no returns to the owner. Public forests administered under long-term programs, therefore, might well assume a substantial part of the country's future production of high-quality material. They should place special emphasis on producing timber of large size and high grade.

FUTURE HOLDS PROMISE FOR FORESTRY

We must plan for a liberal use of timber in an economy of full employment. Unless we visualize a static America, there is no place in our thinking for any plan based on how little we might get along with.

How much timber is our Nation likely to need in the future? As a part of its reappraisal of the forest situation, the Forest Service has endeavored to estimate how much we would be likely to use if we maintain a high level of employment and if suitable timber products are available in ample quantities at reasonable prices.

All told, it looks as though we should strive to build up the growth rate of our forests to something like 20 billion cubic feet a year. Of this, some 65 to 72 billion board feet should be saw timber. This esti-

mate would provide a safe margin for security, for new and unforeseen uses, and for unavoidable losses, with a reasonable allowance for exports. It would also allow for what might be termed "ineffective growth," such as timber growth in scenic and recreation areas, roadside strips, and other areas that we shall wish to reserve from cutting or where harvesting will be economically impracticable.

No one, of course, can say just how much timber we are going to need 50 or 100 years hence. Development of atomic energy and other scientific advances may bring radical changes in our way of living. But such a versatile and useful raw material as wood—and a material that can be grown in continuing supply—should certainly have an important place. Although the assumptions on which the above estimate has been based are unlikely to be wholly realized for many years, particularly because of short supply, there seems to be no reason to believe that potential requirements for wood will be any lower.

Today nearly 90 percent of our timber supply comes from privately owned forest lands. In general, the private forest lands are the most accessible and potentially the most productive. We must continue to look to private forests for the bulk of our timber supply in the future.

Before the war, the lumber industry had little trouble producing as much as consumers demanded. There was enough accessible standing timber and enough mill capacity to turn out even more. Now the situation has changed. It is not likely that the industry will again be able to meet consumer demands in full for years to come. The outlook of a strong demand for forest products should provide a strong incentive for long-term investment in timber growing and permanent forestry operations. Private financing of timber-growing projects should be easier.

In our 1944 report, it was noted that publicity emanating from organizations representing the forest-products industries often tended to lull the public into a false feeling of complacency about our forests—to give the impression that all was well, that there would always be plenty of timber. It is encouraging to note that the program of the American Forest Products Industries, Inc.—a promotional organization representing major forest-industry groups—now places major emphasis on growing more trees. Its program calls for continuous growing of trees on every acre of land suited to that purpose, and for bringing the widest area possible under permanent forest management. Leaders in the forest industries realize that the timber supplies they will need to stay in business in future years will have to be grown as a crop.

Designation of tree farms under sponsorship of forest-industry organizations continues. Started some 5 years ago in the Pacific Northwest, the tree-farm campaign has been extended to a number of States in the South and East. The owners are pledged to a program of timber growing. A trees-for-tomorrow campaign sponsored by pulp and paper companies in the Lake States is encouraging tree planting.

Many operators are doing a good job in utilization of timber formerly wasted. In the Pacific Northwest some companies are going over the land a second time to bring in small logs and chunks ordinarily left on the ground after logging. In some cases, small portable

mills have been used in the woods to do a scavenger job on material left from earlier operations.

Some kinds of trees formerly ignored are now being utilized. Lodgepole pine on the west coast, for example, is no longer considered an unmarketable tree; it is being cut for power poles, box shooks, and lumber.

A large plant to make industrial alcohol from wood waste near Eugene, Oreg., is expected to be in operation before the end of 1946. There are plans for it to turn out high-protein stock feed as a by-product.

All these things indicate that it is now economically feasible to step up management plans and practices well beyond what was considered feasible either on industry or public forest lands before the war.

We must, of course, be continually on guard against the pressure to overcut the forests. Heavy demand may increase the tendency of some operators to liquidate their timber at a rate and in a manner which will undermine future production.

INTENSIVE FORESTRY IS THE KEY TO PERMANENT TIMBER SUPPLY

A realistic, comprehensive, and progressive forest-conservation program must aim at keeping our forest lands productive, building up our growing stock of timber, and making the one-third of our country that is forest land contribute its full share to the prosperity, security, and well-being of the American people. What will it take?

More protection.—Where organized, intensive fire protection has been applied, it has amply demonstrated that forest-fire losses can be greatly reduced. Yet 136 million acres of forest land in the United States still lack any organized protection whatever. And fire control forces and facilities in most of the protected areas fall short of the needs.

We have no way of stopping lightning from starting fires. But 90 percent of the forest fires are started by man, largely through thoughtlessness, ignorance, or carelessness. Ninety percent of our forest fires therefore can be prevented, if and when every citizen can be made to realize the values at stake and the necessity for his individual cooperation.

Science has developed methods of combating some of the most destructive forest insects and diseases—the white pine blister rust and the pine bark beetle, for example. Research is giving promising leads to the control of others. Our combat forces out on the front line in the war against the pests and parasites of forest trees, however, are far from adequate.

The drain on our forests caused by losses from fire, insects, and diseases is pure waste. It should be reduced to a minimum.

More planting.—We are carrying millions of acres of good potential timber-growing land as dead weight. This is land which repeated fires or destructive cutting have reduced to a status of virtual nonproductivity. Some of the poorly stocked or deforested land may some

day come back to a fair degree of productivity by natural means. For much of it, the best way to restore the land to usefulness in any reasonable time will be to plant trees. We need to step up our planting program tremendously, for a full-scale attack on the huge reforestation problem.

Less waste.—Less than half of the wood volume in the average tree cut now goes into usable products. Tops and limbs trimmed from felled trees, broken trunks, and cull logs are left in the woods. More waste occurs through the various steps of manufacture to the finished product. Many species of trees are not harvested because they are poorly suited in form or properties to present uses or present manufacturing methods. We need intensified research and experiment to develop methods for profitable utilization of these wasted materials. We need to encourage better integration of wood-using industries so that one plant will use the waste of another. Reduction in waste, more complete utilization of the forest crop, can help to stretch out our short timber supply, to keep us going while we grow more and better timber for the years ahead.

Better forest practices.—Only 8 percent of all private forest lands are receiving good management. On nearly two-thirds, cutting practice is poor to destructive. The general level of forest practice will have to be raised materially if we are to stop the downward trend of our forest resource and start growing more timber for the future.

We must put a stop to destructive practices. We must encourage wider adoption of really good management practices. Technical foresters have developed proved methods of managing forest lands for continuous production. The technical know-how must be carried out into the woods.

A FOREST-CONSERVATION PROGRAM

These are the things we need to put our ailing forest resource on the road to recovery—more protection, more planting, less waste, better forest practices. We can get these things only by positive and aggressive action on a national scale. Here are the measures which the Forest Service believes are essential to an adequate program of forest conservation:

Regulation of cutting practices.—For several years, the Forest Service has advocated that the public exercise some measure of control over timber cutting and related practices. Some commentators have seen in this proposal a move toward extreme regimentation, socialism, or dictatorship. Actually, the proposal visualizes only those requirements sufficient to prevent the use of destructive cutting practices and to make sure that forest land will be kept in condition to continue growing reasonably full crops of timber. Such regulation should encourage and stimulate progress toward sustained-yield forest management.

The Forest Service has suggested that the regulatory program might well be administered by the individual States, with Federal financial assistance, and in line with basic standards set up by national legislation. There should be provision for direct Federal administration, however, in the States which fail to take appropriate action within a reasonable time.

The Forest Service feels strongly that such a measure is necessary if we are to prevent premature logging of young stands and further deterioration of the timber-growing capacity of our forest lands.

Opposition to public regulation of cutting practices has come mainly from forest-industry organizations. It seems obvious, however, that the proposal fits industry needs today. Many industrial owners already have adopted good practice. Those operators who still use poor or destructive methods would be required to improve their practices. Competition would thus be on a more even plane. Also, relatively few forest-industry concerns have enough timberland of their own to supply all their needs. Many buy all or most of their timber from farmers and other small owners. By raising the general level of forest-management practices, regulation would help to safeguard their raw-material supplies.

Aids to encourage better management on private lands.—To make sure we have the best answers to the many problems of forest management, protection, and utilization and to find the answers to problems yet unsolved we should have an expanded program of technical research. Through research we can find even better and faster ways of growing timber. We can find ways to reduce waste and make the timber cut go farther.

The technical information developed through research should speedily reach the owners who can put it into practice. At the present time the Forest Service is cooperating with State agencies in providing about 150 trained foresters to help farm-woodland owners. Although spread thin through 600 counties, these foresters are helping many a farmer to realize better returns from his timber while at the same time keeping his woodland in better productive condition. But such direct, on-the-ground service should be made available for $3\frac{1}{4}$ million farm-woodland owners in more than 2,000 forest counties. Similar service should be provided for almost a million small nonfarm owners of forest land who thus far have received little help. In addition, technical assistance and advice based on forest-products-research findings and other up-to-date information should be made available to small processing plants and to consumers to help them make better use of wood products.

We should encourage more forest planting on private lands. Under the Clarke-McNary law of 1924 Federal aid is now given to the States in growing and distributing tree nursery stock at low cost. Only farmers can now receive planting stock under this Federal-aid program. Authority for such aid should be broadened to include other forest landowners. The present \$100,000 annual authorization for the work is far too small for any real attack on our huge reforestation job.

Development of cooperative associations of small forest owners also should be encouraged. Individually, small owners are short on bargaining power in marketing their forest products and on equipment and facilities for the most efficient management of their timberlands. Establishment of cooperative associations could be aided by legislation authorizing special studies in this field and loans as needed to carry the cooperatives through the pioneering stage.

Private owners usually have had little trouble financing an operation to liquidate grown timber, but credit facilities for long-term tim-

ber growing are often lacking. The Forest Service and the Farm Credit Administration have given the question much study. With cash so plentiful today, demand for forest credit is probably at low ebb. However, in the long view, it is believed that adequate credit facilities, especially for small owners, will be an important aid to forest conservation. Establishment of a federally sponsored forest-credit system to make long-term loans available on reasonable terms and on conditions adapted to the needs of private forest operators is recommended. Such loans should by all means be conditional upon sound forest practice.

Forest owners also are generally unable to get insurance on growing timber. The Forest Service feels that forest insurance should be brought within the economic reach of the average owner. One means might be through expanding the authority of the Federal Crop Insurance Corporation.

There is still need for improvement in forest taxation. In some States property owners feel that the present tax system militates against timber growing and adds to the pressure for quick liquidation. Inheritance taxes often have similar effect. The Forest Service has long studied the problem and stands ready to advise with States and agencies in their efforts to improve forest tax laws and their administration.

Private forest lands need more and better fire protection. The work on areas now covered should be brought up to par, and protection should be extended to the 136 million acres still unprotected.

More effective protection against forest insects and diseases is essential. The Bureau of Entomology and Plant Quarantine and the Forest Service have recommended new legislation which will declare the Federal responsibility in Nation-wide protection and provide prompt and adequate action to combat outbreaks of destructive pests and parasites. It will provide for State and private participation under flexible arrangements suited to varying circumstances.

Some of these needs are discussed in more detail in other sections of this report.

More public forests.—The foregoing are measures that will help to encourage private enterprise in timber growing. They should go far toward raising the level of forestry practice on private lands.

There are a great many areas, however, that would best be in public ownership, managed and protected as national, State, and community forests. That is the only practical way to assure stable ownership and satisfactory management for those lands which are obviously not suited or destined for successful permanent private development, and for certain key areas where public values are of high importance.

Public ownership is the logical answer for certain areas in regions of scanty rainfall, poor soils, or extreme inaccessibility, where the prospective returns will be too small to offer much incentive for private development; also for certain forest lands that have so deteriorated that they offer no prospect of income for many decades.

For certain other areas where there are acute problems of watershed protection or other needs vitally affecting the welfare of dependent communities, public ownership also will be desirable.

Forest restoration and improvement.—There would be little point in establishing public forests if we failed to develop their full potenti-

alities. On national forests already established, $31\frac{1}{4}$ million acres of partly or wholly denuded land need to be brought back into production by planting. Much improvement work—thinning, pruning, etc.—needs to be done in young stands to speed the growth of usable timber and better its qualities. New forest roads must be built and old ones improved to facilitate use of the forests and give access to undeveloped areas. We need improved facilities for fire protection and reduction of fire hazards and additional administrative facilities.

To realize the full values of our national forests under multiple-purpose management, improvement work is needed in other lines in addition to that calculated to increase growth of timber and facilitate its harvest. Within the national forests are range lands which play an important part in the Nation's production of meat, wool, and leather. Reseeding and other improvements are needed to increase the livestock-carrying capacity of these range lands. More facilities are needed to meet the increasing numbers of recreationists. Upstream work is needed to reduce floods. These needs are discussed elsewhere in this report.

On State and private forest lands, an even larger amount of similar work is needed.

All such work for the rehabilitation and development of our forests is capital-improvement work—an investment that will pay back in increased yields of commodities or service. We are now engaged in a vigorous program of road construction to open up untouched timber for early operation. Range reseedling and other urgent projects are also being attacked currently. The work program could be greatly augmented when needed to help avoid or relieve unemployment. But the needs are so great that a forest-improvement program should not be deferred until we face acute unemployment conditions. A substantial program should be in operation at all times.

TIMBER ABUNDANCE CAN BE ACHIEVED

An abundant timber supply is essential if the United States is to maintain its place as a strong, progressive nation. Wood was a vital necessity in conducting the war; it is just as important to our progress and security in peace. Producing forests are the source of thousands of needed commodities. Producing forests mean jobs. They have an important part to play in maintaining the high level of industrial activity upon which full employment depends.

Our Nation's forest lands can eventually be made to furnish in perpetuity all the forest products we are likely to need, and even help in some measure to supply the needs of other countries less fortunate. But it will take some real doing. The downward trend of our forest resource must be reversed. The scars of past misuse must be healed. We should aim to double our annual saw-timber growth.

And the time for a real, all-out attack on these jobs is now. Prompt action is needed to minimize the pinch of timber shortage in the years immediately ahead and assure abundant supplies of timber for the more distant future.

In the following pages Forest Service activities working toward the foregoing and related objectives are reviewed.

STATE AND PRIVATE FORESTRY COOPERATION

COOPERATIVE FIRE CONTROL

Under the Clarke-McNary law, the Forest Service extends cooperation to the States in the protection of State and private forest lands from fire. For the fiscal year 1946, Congress appropriated \$7,300,000 for the Federal Government's share in this cooperative program. This Federal sharing of the cost of protecting non-Federal lands is not a direct grant-in-aid to the States. Federal allotments are contingent upon the States and private owners providing an amount at least equal to the Federal funds. Of the total of \$16,898,897 spent on this cooperative program in fiscal year 1946, the Federal Government contributed 42 percent; States and counties 44 percent; and private owners 14 percent.

Some bad fires occurred in calendar year 1945 (the latest year for which complete reports are available). But the fire record Nation-wide was one of the best in years. Favorable climatic conditions helped to keep fires down, as did wartime restrictions which prevented the usual number of hunters, fishermen, campers, and tourists from entering wooded areas. The record, however, also reflects effective work in fire prevention and in the States' planning, training, and suppression programs. State and Federal increases in fire-control funds aided in making these improvements.

Fire records show that 48,176 fires occurred during 1945 on non-Federal forest land under cooperative protection. They burned over 2,456,353 acres. This record compares well with the annual average of 73,066 fires, burning 3,219,000 acres, during the preceding 5 years.

Since there is no field organization to report fires on unprotected areas, fire records for these areas are incomplete and should be considered as rough estimates only. The States estimated a 1945 total of more than 68,000 fires on unprotected private forest lands, and some 14,780,000 acres burned over. On the basis of these figures, less than 1 percent of the total protected area was burned, as compared with nearly 12 percent of the unprotected areas.

A 2-year study of Federal-State cooperative forest-fire control completed in 1946, was made to determine present-day protection needs, and costs of providing effective fire-control coverage. The 42 cooperating States collaborated in this study. It showed 439,075,000 acres of State and private land in need of protection and qualifying for Federal cooperation under the Clarke-McNary law. The total area includes commercial and noncommercial forest lands and certain non-timbered watershed lands.

The annual cost of providing effective and adequate protection for this entire area was estimated at \$31,249,000, exclusive of Federal administration and inspection costs. In 1939 a similar estimate placed the cost of adequate protection for all State and private forest lands at \$18,729,000. The revised figure reflects the general increase in costs of labor, equipment, and supplies; the addition of 8 million acres to the total area qualifying for cooperative protection; and a better concept, based on past experience, of what is needed in planning, organization, and supervision to do an effective job of fire prevention and suppression.

According to the Clarke-McNary law principle of 50-50 sharing of cooperative fire-control costs, the Federal Government's share under the new cost figure would be about \$16,000,000. Federal participation under present law is limited to \$9,000,000.

The 439 million acres of non-Federal land on which cooperative fire protection is needed comprise 70 percent of the Nation's commercial forest lands. Effective measures to safeguard these areas from destructive fire loss must take high place in any program designed to increase our timber supply. Some States have established reasonably adequate State-wide protection coverage. Most have not. In a recent study of fire-control standards on non-Federal commercial forest land, only 22 percent of such land was rated as receiving good protection.

Of the 439 million acres needing protection, cooperative protection has so far been extended to 303 million. On some 136 million acres, organized fire control has not even been started. The bulk of the area as yet receiving no protection is in the Southern States.

It is apparent, then, that cooperative fire-protection needs are two-fold. First, protection should be extended as rapidly as possible to those areas needing but not receiving it; and, second, protection should be strengthened in those areas now protected but where fire losses continue to be too great for successful forest management.

TIMBER PRODUCTION WAR PROJECT

The war project to stimulate increased output of timber products was terminated October 31, 1945. The project was started in 1943, when production of lumber and numerous other forest products had failed to keep up with urgent war demands. The decline in output of some 35,000 small sawmills in the eastern half of the country was especially serious. The War Production Board therefore requested the Forest Service to administer a program to assist these operators to maintain or increase their production.

The Timber Production War Project operated in all major forest regions east of the Great Plains. Several other Federal and State agencies besides the Forest Service cooperated. Participating foresters assisted sawmill and logging operators and timberland owners, especially the small owners and operators, in meeting many production problems. In the manpower field, the program encouraged woods work by farm labor during slack farming periods; it aided recruitment efforts, decreased absenteeism, and trained and employed several thousand prisoners of war for logging work. In the equipment field, it aided in preparing and processing applications, located second-hand material needed, and encouraged installation of more efficient machinery. In the stumpage field, the foresters aided operators to locate needed timber, brought stumpage owners and operators together, and assisted owners in the proper marking and management of their timber. The help given operators in understanding and complying with wartime regulations was especially valuable. In addition, special efforts were made to encourage and train operators in the use of more efficient equipment, such as bow saws, power saws, and improved milling machinery. Emphasis was also given to training operators in grade sawing and in piling and seasoning lumber.

In a little more than 2 years, the project assisted operators to turn out an estimated 8 billion board feet of needed forest products that might not otherwise have been produced. On the basis of this estimate, project costs averaged 65 cents per thousand feet produced. Half of this cost represented the value of services contributed to the project by cooperating agencies, especially the State forestry services.

TECHNICAL ASSISTANCE TO TIMBERLAND OWNERS

To provide technical advice and assistance to farm woodland owners in forest management and marketing of timber products, the Forest Service has under way 156 cooperative farm woodland management projects, operating in some 600 counties, in 39 States. Where the States put up 50 percent or more of the cost in cash or in kind, the cooperating State agencies have direct supervision of the projects. In those instances where the State is at present unable to match the Federal contributions, the projects are federally directed. Thirty projects are in this category. The 156 projects include 45 farm forestry demonstration projects formerly under the Soil Conservation Service, which were transferred to the Forest Service in July 1945 in order to consolidate in the Department's principal forestry agency the responsibility for administration of the cooperative farm forestry program authorized by the Norris-Doxey and Clarke-McNary Acts and to better integrate this work with other phases of the Department's forestry work.

In each project a trained forester is assigned to a county or group of counties to work with individual landowners in estimating and marketing timber and working out woodland-management plans. During the fiscal year 1946, the project foresters assisted 12,083 farmers with woodland-management problems on 1,321,746 acres. They facilitated the cutting of 452 million board feet of timber. This included products used for farm needs, but most of the timber harvested was sold. The project foresters also assisted in the harvesting and sale of 5,403 barrels of gum and 48,929 gallons of maple sirup. Some 6,300 small-mill owners and other forest-products operators received advice and assistance from the project foresters.

For nonfarm owners of forest land, very little has yet been done. Aside from work accomplished under the Timber Production War Project, the Forest Service has given technical aid on applying better cutting and management practices to only 1,254 nonfarm forest owners during the past 8 years. Most of this work has been on large or medium-sized holdings. Sixty-six percent of those contacted have adopted improved practices. This technical service to nonfarm owners has been carefully coordinated with similar work of the State forestry services.

Efforts by all agencies, however, while very beneficial, are entirely inadequate. Privately owned forest land will have to grow most of our wood. There are nearly a million nonfarm forest landowners, and all together they possess some 206 million acres of forest land. In this group small owners predominate. There are fewer than 3,600 owners with holdings of over 5,000 acres each, but more than 4 million small owners. In the small-owner group, 86 percent have less than

100 acres each; 70 percent less than 50 acres each. The small holdings are generally in the least productive condition.

These owners need technical assistance because few of them have special knowledge and skill in technical forestry. The average small landowner may acquire these skills in time by working on his own property with expert assistance. But for the immediate future, practically all of the know-how will have to be provided.

Individual assistance is needed because no two forest tracts are alike. With most farm crops the farmer starts with bare ground and grows a crop in a single season. With forest crops, the landowner must start with whatever is on the land now. Most of the privately owned forests have been cut over at least once. Today less than half of the total acreage has operable stands of saw timber. Best results are obtained when the individual owner is shown what should be done on his own particular property.

Operators of small sawmills and other small forest industries also need technical aid. Ninety-seven percent of the 39,000 active sawmills are small—most of them very small. Yet they produce half of all lumber cut. Large operators can afford to hire technicians; through their associations they have facilities for exchanging or requiring up-to-date technical information. Most of the small operators are not members of organized associations. The Timber Production War Project proved that response of small operators to on-the-ground technical assistance was immediate and effective.

COOPERATIVE TREE DISTRIBUTION TO FARMERS

During fiscal year 1946 the Forest Service cooperated with 42 States and 2 Territories in the production of forest tree planting stock for distribution to farmers. This activity is authorized by the Clarke-McNary and Norris-Doxey Acts. A total of 37,743,000 tree seedlings was distributed at cost, or less, for farm planting. The trees are grown in State owned and operated nurseries and distributed by the State foresters. The 42 States, together with Puerto Rico and Hawaii, budgeted \$1,025,000 of their own funds for production and distribution of planting stock during the year. Of this amount, \$687,050 was devoted to growing and distributing trees to farmers. The Federal contribution was \$123,000.

Millions of acres of idle submarginal farm land and nonproductive farm woodland are in need of planting. A stepped-up program of making planting stock available to farmers at low cost will help materially in putting these lands to work. For a broad attack on our reforestation problem, also, the authorization for Federal cooperation in tree distribution should be increased and broadened to include distribution to nonfarm owners of forest land as well as farmers.

COMMUNITY FORESTS

The Forest Service is encouraging counties, municipalities, schools, townships, and other minor governmental subdivisions to establish and maintain community forests. It has assigned one of its experienced foresters to work with local communities interested in establish-

ing such forests. Local public forests have a high social value because they bring forests and forestry close to the people of the community and create a better appreciation of the relation of forests to the commercial and cultural life of the Nation.

Even during the war years there was steady development of new community forests, and there is every indication that the movement will expand greatly in the postwar years. There are now 2,379 established community forests, with an aggregate area of 3,089,361 acres. The number increased by 101 during the year.

In many communities, forests are being dedicated as living memorials to those who served in the war. There can be no more appropriate memorial. A single tree, planted in someone's memory, may not survive. But a forest, properly managed, will live forever—a place of beauty, usefulness, and recreational enjoyment that will keep alive the tradition of service to humanity which characterized the deeds of those it honors.

THE NATIONAL FORESTS

TIMBER MANAGEMENT

Total cut of timber from the national forests under sales and exchanges in fiscal year 1946 was 2.7 billion board feet. This was below the 1945 figure of 3.1 billion board feet. Strikes in the Northwest accounted for most of the decrease.

The importance of the timber resource of the national forests continues to increase as timber supplies of the Nation as a whole decline. As private timber gives out, many communities and industries are becoming more and more dependent on national-forest timber. The demand in many national-forest areas far exceeds the amount which can be cut without sacrificing sustained-yield principles.

During the war the Forest Service bent every effort toward meeting war needs with the personnel available. Timber sales reached the highest volume on record. Advance work in planning and preparation for future sales was largely deferred. With demand for timber so heavy and personnel so reduced, it was not possible to maintain an adequate supply of logging "chances" cruised and prepared for sale. The Forest Service is now faced with the double task of supplying a maximum amount of timber from the national forests to help meet immediate reconversion needs and at the same time bringing up to date the timber inventory and planning work needed for orderly management of the timber resource to insure permanent production and the stability of dependent communities.

Certain industry spokesmen in recent months have accused the Forest Service of hoarding Government timber. Before the war the same sources were complaining about Government timber coming on the market in competition with the timber on their lands. Actually the Forest Service desires to make merchantable timber available from the national forests to the full limit of the forests' sustained-yield capacity. In fact, limited overcutting has been authorized to help meet the urgent immediate needs for lumber for housing. But overcutting will be allowed only where it will not jeopardize the permanent welfare of dependent communities. Subject to the same considera-

tions, more timber will be made available as rapidly as access roads can be built into untouched timber stands.

Increased output is also being obtained wherever possible through commercial thinnings and improvement cuttings. Output of poles for the rural-electrification program and to meet the needs of private telephone, telegraph, and power-transmission lines has been increased.

Progress has been made toward the establishment of working units under the Cooperative Sustained Yield Units Act of 1944 (Public Law 273, 78th Cong.). The act authorizes cooperative agreements for joint operation of public and private timber under sustained-yield plans. Investigation of specific proposals has gone forward, and public hearings were held on one case in September 1946.

Blister rust control work to protect valuable white pine stands has been carried on largely by recruiting workers of high-school age during the summer months. To catch up on work that had fallen behind during the war, particularly in Idaho, Montana, Minnesota, California, and Oregon, expansion of control work was planned in the summer of 1946, but some difficulty was experienced in recruiting enough workers.

There was some increase in insect epidemics, notably in spittle bug damage in jack pine plantations in the Lake States. Insect-control work was carried on there, as well as in California, Colorado, Montana, Nebraska, Utah, and Idaho. Renewed emphasis is being placed on determining insect susceptibility of forest stands and channeling commercial cutting operations to high-risk stands whenever possible.

The size of the insect-control job on the national forests calls for a stronger attack than has been possible in recent years. Reconnaissance and survey by trained specialists is needed to supplement observations by the regular staff; and prompt, direct control work should be possible wherever needed to check potential epidemics.

PLANTING AND TIMBER-STAND IMPROVEMENT

Up to the beginning of World War II, some 1,151,000 acres of deforested land in the national forests had been planted or seeded. Reforestation work was largely suspended during the war years. Some 2,200,000 acres remain on which planting is required to bring the land back into productivity. In addition, about 1,000,000 acres are so understocked that fill-in planting is needed.

The Forest Service is bringing its system of tree nurseries back into production and has set as a goal the completion of planting on these lands in 15 years. This will require planting an average of nearly 215,000 acres a year. Funds available this year will permit planting 27,600 acres. At this rate, the total planting job would take 115 years.

Some planted areas need a certain amount of follow-up care to prevent weeds or brush from choking out the young trees before they become well established. None of this type of work was done during the war.

Up to the present time, virgin and natural second-growth timber have provided almost the entire supply of wood in this country. Man has taken only a very minor hand in growing the trees. Natural processes, however, are slow and do not always result in maximum returns. By using certain cultural methods, foresters can speed up

growth and yield of desired products. Cleanings in young stands can favor desired species. Thinnings can be made to get the best spacing and increase growth rate of individual trees as much as 50 to 100 percent. Sanitation or improvement cuttings can remove diseased trees or trees of poor form that are wasting good growing space. Pruning of pole-size timber will result in growth of knot-free wood at a much younger age than would naturally occur. At a cost of \$12 to \$15 per acre, pruning in young conifers may increase the value of the products finally harvested by \$100 or more per acre.

Such timber-stand improvement as is now being accomplished on the national forests is done on sale areas through use of cooperative funds collected in connection with the sale of the timber, or through commercial sales where the products of thinning are salable. It is conservatively estimated, however, that there are 3,750,000 acres in the national forests on which timber-stand-improvement work would be a good investment. This is in addition to areas where such work can be done by means now available.

ROADS, TRAILS, AND OTHER IMPROVEMENTS

Under the wartime access-road program, the Forest Service was called upon to supervise 257 road projects to provide access to timber stands or strategic mineral deposits. By VJ-day, work had been completed on 148 mineral-access projects and 85 timber-utilization projects. All but one of the remaining approved projects were completed during fiscal year 1946.

A new program of timber-access road construction in the national forests is now going forward. Some \$7,000,000 from regular Congressional appropriations was allocated to this work for fiscal year 1947, and this amount has been supplemented by funds made available by the National Housing Agency.

Access-road construction is being given first priority in view of the critical lumber shortage. But the over-all transportation requirements for proper protection, administration, and utilization of the national-forest resources should not be lost sight of. Many national-forest highways are important connecting links of county, State, or transcontinental highway systems and form part of the haul essential in moving timber from mills to markets. There was practically no construction on forest highways during the war and many highways deteriorated rapidly because of heavier loads and postponement of maintenance work.

The planned system of secondary or development roads for the national forests totals 138,167 miles. Of this planned system, 53,438 miles are now of satisfactory standard; 46,976 miles are of unsatisfactory standard; and 37,753 miles are still nonexistent.

The planned trail system is 165,138 miles, of which 88,006 miles are of satisfactory standard; 56,054 unsatisfactory; and 21,078 miles as yet only on paper.

In many large areas the planned road and trail system is therefore far from completed. It is often necessary for fire fighters to travel from 10 to 35 miles on foot over steep country to reach fires in such areas. Delayed attack means the fires grow large and the costs of suppression mount. Construction of airplane landing fields in

isolated areas will make it possible to speed up fire-control work. More facilities for air transportation may also make it possible to eliminate certain roads from the planned system.

Construction and maintenance of administrative facilities in the national forests was limited during the past 5 years to work essential to protection of strategic facilities and operations for war purposes. Not only has there been practically no new development in line with the increasing use of the national forests, but the backlog of replacement requirements has been accumulating. Plans are ready for rehabilitation of run-down improvements and construction of needed new facilities as rapidly as funds become available. Planned developments include range-fence and livestock-watering projects, recreation improvements, lookout stations, landing fields, telephone lines, ranger offices and dwellings, barns, warehouses, bunkhouses, and sanitary systems.

Forest Service engineers have developed a number of items of new equipment especially adapted to maintenance and improvement work on the national forests. Among the newest inventions is a "trail beetle," a tiny crawler tractor weighing only 1,800 pounds, designed for trail-maintenance work. Another is the "trail mule," a three-wheeled motor-driven, freight-carrying cart that will negotiate mountain trails. A small compressor has been designed to supply air for a jackhammer for use on trail jobs. In contrast to these midget items is the new giant "tomcat" logging tractor, combining a tractor and logging arch in one compact unit, designed for snaking out and yarding logs in difficult terrain.

During the war the Forest Service's Engineering Division was engaged in special war-mapping projects for the Army and Navy. After VJ-day the Navy Department requested continuation of Forest Service assistance in the preparation of maps by photogrammetric methods. Most of this work has now been completed, and the Division is shifting from war activities to preparation of maps needed for regular Forest Service work. Maps adequate in scale, accuracy, and detail are available for only about 15 percent of the national forests. Most maps in use are obsolete. Contracts were awarded in 1946 for aerial photography of approximately 34,000 square miles. New methods and equipment, such as a camera transit, photo transit, and radial-line plotter, have been developed to obtain greater accuracy and increased production in mapping work.

FIRE CONTROL IN THE NATIONAL FORESTS

The Forest Service fought 9,985 fires within national-forest boundaries during the calendar year 1945. Eighty-five percent of them were topped while still small, before they could cause heavy damage. Total area burned was 175,882 acres—nearly 60,000 acres less than the average of the preceding 5 years.

This favorable record was achieved in spite of the fact that national forest-fire organizations were seriously weakened by shortage of trained men and fire-fighting labor and by deterioration of equipment kept in operation during the war years beyond its normal life.

Weather conditions during the summer season were critical in the west coast States. The great Tillamook fire, although not on national-

forest land, strained all fire-control resources in Oregon. Serious fires occurred, too, in California, damaging valuable timber and watershed lands.

Generous assistance from military forces helped to offset some of these difficulties. The "firefly" project, in which the Army cooperated with Forest Service and State protection forces by assignment of parachute troops, was a valuable aid. The project was set up on the west coast to meet the threat of Japanese incendiary balloons. The Japanese abandoned their balloon barrage before the season of greatest fire danger, but the firefly project proved invaluable in strengthening the fire-fighting forces of the west coast when fire conditions became critical. The project was disbanded late in the fall of 1945.

Damage from fires in the national forests in 1945 was placed at \$999,485. This was chiefly loss of marketable products. No attempt was made to estimate dollar values represented in damages to such things as watersheds, trout fishing, and beautiful scenery, all of which are highly valued by the public.

During the early part of 1946 there was a sharp increase in number of fires. Some bad fires occurred in the Southwest, but up to July 1 total acreage loss remained below the 5-year average.

Costs of fire fighting in 1945 were up 10 percent over the 5-year average and are rapidly increasing, reflecting the increase in prevailing wage rates and the change in purchasing value of the dollar.

The postwar period calls for rebuilding fully effective peacetime fire-control organizations adapted to present conditions on the national forests. Means must be found to make up for the loss of the substantial military help given during the war and the Civilian Conservation Corps manpower available in the prewar years.

Several developments are now under way looking to more effective fire protection under changed conditions. Smoke-jumper crews (fire fighters trained in parachute jumping) are being expanded in the Northwest to make possible quick aerial delivery of men to fires in inaccessible mountain country. With the cooperation of the Army, the Forest Service is testing the value of helicopters for moving men and equipment to fires without recourse to parachutes. Plans have been made also for increased mechanization of fire fighting—to reduce the need for large forces and sweating hand labor on run-away fires, and to increase the effectiveness and striking power of the regular forest-fire organization.

PROTECTION, DEVELOPMENT, AND MANAGEMENT OF WATER RESOURCES

The Flood Control Act of 1944 authorized work on a number of flood-control projects. Of these, the Forest Service is participating in programs on the Santa Ynez River watershed, in California; Buffalo Creek watershed, in New York; Potomac River watershed, in Pennsylvania, Maryland, Virginia, and West Virginia; Coosa River watershed, in Georgia; Yazoo and Little Tallahatchie River watersheds, in Mississippi; and Trinity River watershed, in Texas. These projects involve both national-forest and other lands.

Flood-control work on the Los Angeles River in California was started under earlier authorizations before the war but was suspended

during the war years. Pursuant to legislative instructions, however, detailed planning was resumed during the last year of the war to permit rapid resumption of construction activities when the war ended. In May 1946, work was resumed on fire-control improvements and erosion-control structures in channels.

Preliminary work looking to commencement of field operations in fiscal year 1947 has begun in the eastern and southern projects. Planning in the Yazoo and Little Tallahatchie watersheds was initiated but later interrupted, because of action of the Mississippi State Legislature, which withdrew State consent to further acquisition of land by the Federal Government. Public acquisition of certain areas to assure maintenance of corrective measures on the most impoverished land in the watersheds is an important element in the Yazoo and Little Tallahatchie projects.

Emergency treatment was undertaken to prevent flood damage from a 16,000-acre burned area in the Boise River watershed in Idaho. Remedial work consisted of sowing perennial grasses, largely by airplane, on the burned land.

Work has been started in developing improved watershed-management plans for national forests or watershed subunits of forests. The new plans look to integrating uses of the forests' resources to assure essential watershed protection and improvement of watershed services. Further studies are necessary to determine actual and potential water yields, soil factors and other conditions, and present and prospective local water requirements, as a basis for achieving the best protection and development of the water resources.

National forests supply most of the water for major streams and population centers of the Western States. Water supply will set the limit for ultimate growth and development in much of the West. In the East, too, national forests are important to the permanent protection and assurance of good local water supplies in many areas.

RECREATION

In 1941, the last prewar year, recreation areas in the national forests received 10¾ million visits. Even during the war more than 6 million visits were reported. Recreational use rebounded rapidly when gasoline rationing and other restrictions ended. Use since VJ-day has been at rates exceeding that of 1941. Undoubtedly use is going to continue at a high level for many years to come.

Recreational use is measured in number of visits rather than visitors because the same nose may be counted more than once on different forests during the season. The visit figures cover only those who use national-forest recreation facilities; they do not include the additional millions of tourists, sightseers, and travelers who merely pass through.

The Forest Service has constructed 4,300 camp and picnic areas, 254 winter-sports areas, 201 swimming areas, and 54 organization camps. The latter are permanent camps suitable for group outings. They are made available to civic and welfare organizations which provide free or low-cost summer vacations for various groups—especially for underprivileged children.

Under special-use permits, with appropriate controls to safeguard the public interest, the Forest Service also has permitted private capital to construct 311 organization camps, 488 commercial resorts, and

100 ski tows and lifts. Sites have been leased to individuals for more than 12,000 summer homes.

The improved public areas are capable of accommodating 281,000 persons at one time, while the privately owned resorts and camps can house some 50,000 persons who desire more comfort and convenience than the free public areas afford.

Even this large development of recreational facilities has been inadequate to meet the public demand. Many areas near population centers have been continuously overused and are deteriorating as a result. Heavy trampling and use kills trees and shrubs, increases dust, and makes the area less and less attractive. Since maintenance work was largely suspended during the war, there has been serious deterioration of latrines, water systems, fireplaces, shelters, bathhouses, parking areas, and other facilities at most recreation areas.

With a deficiency appropriation for fiscal year 1946 and a special appropriation for 1947, the tremendous job of restoring national-forest recreation areas to safe and sanitary condition is being undertaken vigorously. It is expected that the job will be half done by the summer of 1947. The size of the restoration job and the critical shortage of building supplies precluded any major new construction program in the current fiscal year.

Definite plans have been prepared, however, for new recreation areas and expansion of existing facilities urgently needed to relieve overuse in many localities. This work will be undertaken as funds and materials become available.

Heavily used areas require full-time attention of caretakers during the vacation season to control the use, maintain sanitary facilities and water systems, keep the areas clean, and dispose of garbage and refuse. On smaller areas this work is done by part-time attention of seasonal or regular field personnel. Lack of enough caretaker help may result in widespread pollution of water supplies and extensive forest-fire damage, not to mention danger to the health and safety of the visitors themselves.

Winter sports have increased greatly in popularity, and the need for more areas, ski lifts, winter resorts, and improved skiing terrain is apparent. This activity poses new and difficult problems of meeting the needs and looking to the safety of large numbers of people in high country under winter conditions. A million visits to winter-sports areas were expected in 1946.

WILDLIFE MANAGEMENT

National forests are the home for a large portion of the Nation's wildlife. They support one-third of our big-game animals. Many kinds of small game, such as squirrel, ruffed grouse, and wild turkey, are found on national-forest areas. Within these forests are 90,000 miles of fishing streams and 1½ million acres of lakes.

Now that the war is over, it is apparent that public demand for hunting and fishing will expand rapidly. In 1945 a total of 3,028,000 hunters and fishermen came to the national forests. It was expected that the number seeking this form of outdoor recreation in 1946 would approach, if not exceed, the 1940 peak of 3.6 million.

Most of the Forest Service's wildlife specialists were assigned during the war years to more urgent wartime duties. An effort was made,

however, to maintain established cooperative programs with the States and to give attention to areas where protection of forest resources was involved. On a number of areas deer and elk populations have increased beyond the capacity of the range to support them. Serious damage to soil and vegetation and starvation and disease loss in the herds are resulting. Special programs in cooperation with State authorities are needed in such areas to improve the utilization of the big-game resource, and to bring big-game numbers into balance with the natural food supply.

In view of the importance of the wildlife resource and the growing public interest in hunting and fishing, the Forest Service is aware of the need for resuming an adequate peacetime wildlife program. The first requirement is to restore wildlife specialists in the regional offices and later on many of the national forests. These men will help coordinate wildlife management with timber and range management, recreation, and other uses of the land. They can also take up and expand the cooperative work with the States. This is highly desirable. Cooperative effort with the States has always been a part of the Forest Service wildlife policy.

A big backlog of stream- and lake-survey work, game inventories, and studies of range conditions has accumulated. Much of the information on fish and game numbers, distribution, and environmental conditions has not been adequately field-checked for 5 years or more. It is hoped that work can be resumed soon on stream improvement, game-range improvement, and other projects that will make for better fishing and improve the habitat for game.

GRAZING IN THE NATIONAL FORESTS

More than 80 million acres of national-forest land are suitable for livestock grazing. In 1945, permits were issued to 30,330 owners to graze 1,290,332 cattle and horses and 3,896,258 sheep and goats. Average time on the forests for cattle was 5.6 months; for sheep, 3.1 months. Average charge for cattle was 25 cents per head per month; for sheep, 6 cents per head per month. Total revenue from grazing use in the last fiscal year was \$2,059,676. Counting the young stock, for which no fee is charged, approximately 9 million animals used the forest ranges.

To provide wise and constructive management for the grazing areas within the national forests is one of the most important responsibilities of the Forest Service. The national forests play a significant part in the Nation's total production of meat, wool, and leather. Successful operation of 26½ million acres of ranch properties, representing investments of around \$330,000,000, is largely dependent on part-time grazing in the national forests. The citizenry of a large number of communities have built up their enterprises in the expectancy of sustained production from adjacent national-forest range lands. Forest ranges are parts of the watersheds of many important streams. Misuse of the range can result in serious floods, and waste of usable water. Erosion and silt deposits from depleted range can shorten the useful life of important irrigation reservoirs.

Currently, the Forest Service is facing two very important problems in range administration. One of these is to protect the ranges that are now in good condition—to make them continue to yield a max-

imum of forage. The other problem is to build up those ranges that have deteriorated as a result of prolonged or recurrent droughts or too heavy grazing in the past.

The first of these problems is well in hand. Forest officers and stockmen both have learned a great deal from the mistakes of the past. They have a much better understanding of what constitutes proper use of the range. Where the range is now in good condition, the prospects for keeping it that way are most favorable.

On the second problem, that of building up damaged ranges, much remains to be done. Some 26 million acres need corrective action of one kind or another, such as better handling of the livestock, more fences and water developments, range reseeding, or adjustments in seasons of use and number of animals. Where adjustments in seasons or reductions in numbers are necessary, the Forest Service endeavors to bring about the changes gradually so as to cause as little hardship to permittees as possible. Such considerations have delayed many adjustments that should have been made long ago.

The outlook, however, is not wholly discouraging. Special emphasis is being given to improved range-management plans. Permittees in many cases are voluntarily keeping part or all of their livestock off the range for a period to allow forage recovery.

Ten-year term permits have been renewed in every case where the holder is qualified and range is available. Thus every permittee whose range is properly stocked enters the new term period—1946-55—with all feasible assurance of undisturbed use during the next 10 years.

Range reseeding gives promise of restoring some depleted ranges and increasing grazing capacity in many areas. Sound methods of reseeding certain types of deteriorated range lands have been sufficiently developed through research and experiment to enable the Forest Service to proceed with confidence that the operations will be successful and productive of worth-while results. By reseeding the critically depleted range lands with desirable forage species, grazing capacity of the lands can be increased by thousands of cow-months and watershed conditions immensely improved. Increased forage production on reseeded areas will help relieve grazing pressure on adjoining heavily grazed lands. The Forest Service estimates that the area most urgently in need of reseeding amounts to about 4,200,000 acres. For the current year, Congress has appropriated \$500,000 for range reseeding.

Ground squirrels, prairie dogs, pocket gophers, and kangaroo rats consume and destroy a great deal of forage that should go to the production of meat and wool. Rodents also often cause serious erosion in important watersheds. Normal populations of these animals do not constitute a problem, but they have reached epidemic proportions on more than 5½ million acres in western national forests. Little rodent-control work has been done since the Civilian Conservation Corps program was discontinued in 1942.

NATIONAL-FOREST PROPERTIES

The national-forest system now includes 152 national forests, and 42 purchase units established with the approval of the National Forest Reservation Commission. In addition, 15 experimental areas and several land utilization projects are administered in conjunction with the national forests. These various administrative units together in-

clude a gross area of 228,759,969 acres, of which 179,726,390 acres are publicly owned and managed by the Forest Service, or in process of acquisition. National forests and purchase units are situated in 40 States and in Alaska and Puerto Rico.

The problem of adequately consolidating and developing these national forests in the interest of effective and economical management and so that they may fully perform the functions for which they were established is an ever-present and urgent one. No funds were appropriated for purchase of lands in fiscal year 1946. There was, however, considerable interest among landowners in the exchange of privately owned forest lands for national-forest lands or for timber. During the year, title to 135,678 acres of land was vested in the United States for national-forest purposes, in exchange for which were granted 12,021 acres of national-forest land and 331 million board feet of timber. One hundred and seventy-three new exchange proposals were processed by the Forest Service and approved by the Secretary of Agriculture. When completed, these transactions will add 358,673 acres to the national forest in exchange for 10,582 acres of national-forest land and 320 million feet of timber. These exchange transactions go beyond mere consolidation of national-forest properties. Through them many desirable adjustments of ownership are effected between the public and owners of private property within forest boundaries, to the advantage of both.

During the past year 17 donations of land, aggregating 3,262 acres, were accepted.

Within the exterior boundaries of the national forests and purchase units some 49 million acres are in other than Federal ownership. Of such lands approximately 14 million acres appear to have such values for purposes other than public forest that they are likely to remain in private ownership. The other 35 million acres are of the same types and potential uses as the lands now managed as national forest. The uses to which such intermingled private lands are subject frequently nullify the objectives toward which national-forest management is directed. Administration, supervision, and fire suppression are more difficult and expensive; large outlays of time, effort, and funds are required for the establishment of rights-of-way for the movement of national-forest resources and the development of systems of roads, trails, telephone lines, and other requisites of effective management. Except for such parts as may be made subject to cooperative sustained-yield agreements under Public Law 273, these 35 million acres should be acquired and managed as integral parts of the national forests.

Prior to the time when the national forests were established, the most accessible and productive public-domain forest lands in large measure had passed into private ownership under very liberal land laws. The general practice, therefore, in establishing national-forest boundaries was to exclude areas largely or wholly in non-Federal ownership. In consequence, the national forests as they now exist frequently fail to take in all of the logical forest units of which they are parts. Marginal fringes of privately owned lands, of which large parts are now cut-over, adversely affect the protection, management, and utilization of the national forests in much the same ways as the privately owned lands within the national-forest boundaries. Of such marginal lands there are at least 12 million acres which should logically be acquired and included in the national forests.

However, the existing national forests and their margins are not the whole picture. There are other areas of forest lands, geographically separated from the existing national forests, where circumstances and conditions are such that their dedication to permanent management as national forests would be a wise measure. These areas involve the same problems of timber growth, the same major questions of watershed protection, the same complex of local economic pressures, the same need to safeguard basic values. Measures necessary to preserve their capabilities for social and economic service are not now in prospect or reasonably assured.

The future welfare and security of the Nation will be markedly strengthened and the forest economy of the future will be made more secure if lands in these three categories are brought into permanent national-forest status.

The Congress has appropriated \$3,000,000 for purchase of lands in the fiscal year 1947, and this activity will therefore be resumed. Substantially larger sums, however, will be necessary if satisfactory progress is to be made toward meeting the problems outlined above.

Studies made during the past year of areas acquired during the war for military camps, maneuver areas, bombing ranges, and similar uses indicate that these include about 1¼ million acres primarily valuable as forests and watersheds which should be continued in public ownership and managed as national forest. Legislation to authorize transfer of such areas without reimbursement after declaration as surplus by the military, or provision of funds for reimbursement under the Surplus Property Act of 1944, is necessary to effect the transfer of these lands to a national-forest status.

Although much of the land that might be acquired for national-forest purposes now pays little or nothing in taxes, local governments are often reluctant to see such lands taken off their tax rolls. In lieu of taxes on national-forest lands, the Federal Government under present laws turns over 25 percent of the yearly national-forest receipts to the local governments. Different national forests vary widely in receipts from timber sales and other uses, and the receipts on a given forest may fluctuate considerably from year to year. Denuded lands, newly acquired, bring in few receipts during the period of restoration. Some method is needed that will put the Federal financial contributions to local governments on a more stable and equitable basis, fair both to the local units where the lands are situated and to the Federal Government, which must bear the burden of their rehabilitation and management. The Forest Service favors an arrangement that would provide for an annual payment of a fair percentage of true value of the national-forest property, probably three-quarters of 1 percent.

RESEARCH

RESEARCH WORK CENTERS

A major development in 1946 was the organization of local research work centers under the Southern and Southeastern Forest Experiment Stations. The research work centers are set up to serve distinct regions in which forest types and economic conditions are relatively homogeneous. In the Southern Station territory eight such research centers

are organized, each serving about 10 million acres. Under the Southeastern Station there will be three similar research centers. One or more experimental forests will be maintained in connection with each center as field laboratories at which problems can be studied and results tested on a pilot-plant basis.

The Forest Service now plans to develop similar research work centers throughout the country. Under this plan forest research will be localized, and each of the many forest types in the country will be thoroughly studied. Although the emphasis at these research centers will be on the practical application of research findings, at each station fundamental studies will be carried forward to provide a sound knowledge of basic principles as a background for practical developments.

FOREST PRODUCTS INVESTIGATIONS

The work of the Forest Products Laboratory, maintained by the Forest Service at Madison, Wis., has been in transition during the past year from an all-war program to one of investigations and technological developments for peacetime needs. This was largely a change in emphasis rather than a basic change in the research program, since most wartime uses of wood are not fundamentally different from peacetime uses. Many of the war developments, in fact, have great promise for adaptation to peaceful uses.

The goal of 2,700,000 houses to be built by the end of 1947, set by the National Housing Agency, would require more materials than are likely to be produced by manufacturers of the kinds customarily used. It will be necessary, therefore, to utilize fully all satisfactory new materials. At the request of the National Housing Agency, the Laboratory has begun the testing of such materials as are submitted and is assisting in making an evaluation of their suitability for housing.

The fullest efficiency to be derived from wood in house construction is in large part dependent on how dry it is at the time of installation. Home buyers are in for trouble when green or partly dried lumber is used. Every effort should be made to see that properly dried lumber is available for the housing program. One of a number of methods by which the Forest Service is contributing toward this end is instruction in the seasoning of wood. Courses in kiln-drying methods conducive to increased output of dry lumber with a minimum of degrade losses and at reasonable costs are being conducted at industrial centers and at the Forest Products Laboratory.

Information on glues and gluing in prefabricated-house construction was made available for prefabricators of stressed-skin house panels. Information on increasing the fire safety in houses was published also.

A preliminary study of the flame-spread characteristics of 20 interior fiber insulation boards, produced by 11 different manufacturers, was completed. Several test methods were used in evaluating boards as furnished by the manufacturers and after the application of different fire-retarding preparations. When applied in adequate amounts, several of the preparations were found sufficiently effective to permit treated boards to meet the Federal specification for "slow burning" classification.

In addition to advising on miscellaneous pole-treating and pole-specification problems for the Rural Electrification Administration several specific projects were undertaken to acquire information most helpful to REA in its efforts to meet its heavy demand for treated power-line poles. Tests in the green condition were completed for jack pine and red pine from Minnesota to obtain further data on these species because of their possible expanded use for poles.

A method of determining the properties of cushioning materials was developed to guide their use in the design of cushioned packages for the shipment of machinery, instruments, and other products subject to damage in transit. Such a method fulfills a need long expressed by such organizations as the American Society for Testing Materials, the Technical Association of the Pulp and Paper Industry, and by industry in general. Selection of cushioning materials hitherto was purely a trial-and-error procedure, and no method was available for determining the actual volume of cushioning material needed. Many packages were either underdesigned and consequently subject to a high percentage of breakage, or overdesigned and wasteful of materials and shipping space. The Laboratory's work will enable manufacturers of cushioning materials to develop new cushions and design packages to meet the specific needs of any industry. The growth of freight shipment by air will emphasize the need for accurate design of packages of minimum weight and volume.

Methods were devised for applying radio-frequency heating to the setting of glues in wood products, including design details for necessary electrical equipment, and inexpensive presses and pressing methods. Work in this field demonstrated that high-frequency dielectric heating can be employed advantageously in the mass production of articles which require the use of expensive jigs and other apparatus. The rapidity with which the glue is set—in seconds rather than hours—enables manufacturers to use such apparatus at a much faster rate, thus cutting unit costs of their products. High-frequency heat appears to hold especially great promise in furniture manufacture and production of laminated timbers for structural purposes and shipbuilding.

The Laboratory was instrumental in bringing a basis of order to the hitherto chaotic field of water repellents for lumber and plywood. This has been achieved by establishing suitable methods of testing water-repellent preservatives on which specifications can be based, by developing formulas for satisfactory water-repellent preservatives and by clarifying nomenclatures and definitions that differentiate water-repellent preservatives from the preservative wood sealers. Water-repellent preservatives give wood moderate protection from rapid changes in moisture content and from attack by bluestain and decay fungi without resort to inconvenient or expensive methods of treatment. Many peacetime uses are anticipated in a variety of wood products, such as doors, window sash, and some furniture, where the moderate protection afforded by the water-repellent preservatives is adequate.

A process was developed by which alpha cellulose can be produced from wood in greater quantity per unit of raw wood and in purer form than is possible by present pulping methods. Wood cellulose can be used for such diverse products as sausage casings or rayon

for truck tires. Chemically, the product is similar to cotton-linters alpha cellulose. The process yields, on a commercially feasible basis, 48 to 50 percent of high-grade alpha cellulose from semichemical pulp as compared with yields of about 38 percent of a more degraded alpha cellulose from present pulping processes.

A method which involves the use of test papers was developed by the Laboratory for the detection of sulfa drugs in human beings. It has been employed for control work by the United States Public Health Service.

In March 1946, at the invitation of the Forest Products Laboratory, representatives of virtually every important wood-producing region met to exchange information and ideas at a Nation-wide conference on State and Federal forest-products research programs. The conference made possible a clear up-to-date picture of just what problems of forest-products research are being concentrated upon, the varying objectives of the institutions represented at the meeting, the scope of existing research facilities and projects, and the research needs of the different States and regions.

A well-supported research program aimed at improving the usefulness of wood, reducing waste and inefficiency, and developing new uses for forest products can help us realize greater values from the forest than ever before. To help meet the vast demand for housing, we need research to develop improved prefabrication techniques; to expand the species base for plywood; to develop durable, fast-drying paints for factory application, improved joints and fastenings, better application of laminated construction, and many other things. New methods and processes are needed for economically utilizing the large quantities of disease-, insect-, and fire-killed timber now left to rot in the woods, and the waste material at the mills. We need to know more about the properties and possible uses of various foreign woods—especially tropical woods—that might supplement our own timber supplies. Advances in processing and chemical conversion are pointing to new possibilities in wood utilization, which may create new industries and more jobs and contribute greatly to the comfort and well-being of the American people.

FOREST MANAGEMENT RESEARCH

Work at the Crossett Experimental Forest in southern Arkansas is indicating some practical applications of good forestry practice. Here the Forest Service has a 40-acre farm woodland which, since 1937, has been treated as though it belonged to a farmer interested in making annual harvests of timber products for his own use and profit. To date, the stumpage value of products removed has averaged \$3.99 per acre per year. At the same time, under the cutting practices applied, the growing stock has been gradually increased. Records of the amount of labor used in felling the trees and preparing them for sale show that the farmer would have earned \$1.13 per hour for his work in the woods. In comparison, a cotton grower would have gotten 15 to 30 cents per hour for producing his cotton crop.

The Lake States Forest Experiment Station has found methods for getting better reproduction of yellow birch—one of the most valuable

species of the region—and of black spruce, a desirable pulpwood species, after cutting.

Experiments at the Lake States station showed that judicious thinning can increase the pulpwood yields of jack pine stands by as much as 20 or 25 cords per acre in the first 50 years of the stands' life.

In Pennsylvania, the Northeastern Forest Experiment Station found that northern hardwood stands growing at an average rate of 1 cord per acre per year could be made to grow 1.86 cords per year after thinning. Removal of trees of poor vigor increases the rate of growth of the stand in spite of the reduction in number of trees per acre.

At the Pacific Northwest station it was found that stagnated stands of young ponderosa pine respond well, although slowly, to thinning.

The Northeastern station continued studies on methods of revegetating eroded lands in the Pennsylvania-Maryland section. It was found that spring planting is better than fall in this area; that mulching is valuable for fall planting and for direct seeding with pine and is essential on infertile sites. Of all the species tested, black locust is the only one which responded vigorously to fertilizer use at the time of planting.

During the year a study of shelter-belt plantings was made in the Plains States. Of 1,079 belts examined, 90 percent were in a satisfactory condition. The shelter belts now average 9 years old and the average height of the trees is 16 feet in North Dakota, 20 feet in Nebraska, and 24 feet in Texas.

At the Institute of Forest Genetics, a branch of the California Forest Experiment Station, a number of hybrid pines have been developed with more rapid growth rates than one or both of the parents. If seed of these hybrids can be obtained, they will be tried out extensively in field planting.

In the naval stores research center in northern Florida, pilot-plant tests of chemical stimulation of gum flow, according to methods previously developed by the Forest Service, showed a net profit in 1945 from acid treatment of about \$1,300 per crop.

Although responsibility for research in the fields of insect and disease control rests with other bureaus of the Department of Agriculture, the Forest Service has been closely associated with a number of projects. At the Northeastern station a scheme for reducing the spruce budworm hazard to spruce-fir forests has been worked out. This consists in removing from the stand overmature balsam fir, which are the most susceptible to attack by the insect. A forest-type map that had been prepared for the State of Maine, on which areas with large volumes of overmature balsam are indicated, will be of assistance to private landowners and others in planning for cuttings so that the most risky areas can be cut over first.

In California studies were continued in the reduction of mortality from bark beetle attacks. Where silvicultural-control treatments had removed susceptible overmature ponderosa pines, the average mortality from bug kill during 1945 was only 1.4 board feet per acre per year, while in untreated virgin stands mortality amounted to 16.1 board feet per acre.

Publication of the monograph Longleaf Pine in 1946 with the cooperation of the Charles Lathrop Pack Forestry Foundation culminated

years of work at the Southern Forest Experiment Station. This monograph brings together all that is known to date on the characteristics and use of this important species and its management for timber and naval stores.

Changed conditions have brought forward new problems in forest management research. Timber shortages and new ways of utilizing wood have created a demand for many species heretofore considered worthless. Changes in composition of reproduction in important forest types following better fire protection call for new studies of the silvicultural management of the species involved.

In fire research there is need for further study of the basic principles of combustion, for further improvement in fire-danger measurement, and for further experiments in the use of prescribed fire to lessen the risk of wild fires.

RESEARCH PROGRAMS PROPOSED IN THE PLAINS STATES AND ALASKA

The McSweeney-McNary Act of 1928 authorized the establishment of forest experiment stations in the Great Plains region and in Alaska, but no funds have as yet been appropriated for these purposes.

Tree consciousness is probably more widespread and intense in the Plains area than anywhere else in the country. Since the earliest days of settlement, farmers have persisted despite many failures and discouragements in efforts to grow trees to shelter their buildings and livestock, improve their surroundings, and protect their fields from blowing and drying. All together there are some 750,000 acres of man-made forest in the region. About one-third of this is shelter-belt plantings made under the Prairie States Forestry Project from 1934 to 1942. Past experience aided in the successful establishment of nearly 20,000 miles of these shelter belts on 35,000 farms. Little information is available, however, as to the best cultural treatment for such belts, to maintain their effectiveness for field and crop protection. Better methods of establishing shelter belts at lower cost also are undoubtedly possible for prairie farmers. There is great need for studies of planting methods, tests of new species and strains suited to the plains, and determination of how and under what condition of soil and climate trees can be most successfully grown.

In this region also are some 12 million acres of farm woodlands. Owners have so far had to rely on woods-management practices developed elsewhere, and poorly suited to the conditions of the Plains states. Overcutting and promiscuous cutting have already seriously depleted the woods of the best species and trees of good quality. Research in the care and management of woodlands in the Plains region is badly needed.

The future of Alaska depends in large measure on how its timber and range resources are protected and used. The dense, largely unlogged coastal forests of southeastern Alaska are attracting the interest of forest industry. Pulpwood possibilities are especially promising. These coastal forests contain some 85 billion board feet of timber. Properly managed, they could supply perhaps a billion feet a year in perpetuity. Ninety-eight percent of this timber is in

national forests. Its sound development and orderly use is therefore a Forest Service responsibility.

So far there has been no organized forest research in Alaska. Extremely limited information is available as to the best methods of cutting and management to assure perpetuation of desirable growth, the economic possibilities for forestry, and the milling and processing methods best suited to Alaska conditions. Forests are one of Alaska's major resources. They should be managed and utilized foresightedly, on the basis of sound knowledge.

STUDIES IN MANAGEMENT OF WATER RESOURCES

National concern for the water resource is growing. Increasing urban development has focused attention on greater supplies. The desire to create opportunities for veterans in western agriculture has intensified interest in irrigation projects. An electric age is calling for greater hydroelectric development. Lowering ground-water tables and the sedimentation of reservoirs and channels are now being viewed with real alarm. Floods continue to interrupt commerce and waste resources. This interest in water utilization and control is being extended to the watersheds as the realization grows that many water problems are directly related to land misuse.

The Forest Service as custodian of millions of acres of watershed lands is deeply concerned with the problems of water utilization and control. Investigations seeking the best practices, methods of treatment, and uses of forest and range lands that will yield maximum quantities of usable water are an important part of the research program.

Work on watershed problems at various experimental forests was curtailed during the war, although the more essential field installations were kept in operation through the war period. An accumulation of records now awaits analysis and interpretation. Valuable aid was received from the Civilian Public Service Camp on the San Dimas Experimental Forest in California, both technically and in the operation and maintenance of lands and equipment.

Installations at the Coweeta Experimental Forest in western North Carolina continue to yield outstanding information as to the protective value of watershed forests. On seven small watersheds the forest has been subjected to different treatments. After several years the data from these demonstrate that by forest management methods it is possible to change the characteristics of streams markedly as to the rate, volume, and character of flow. Additional treatments are proposed for other watersheds in this area.

The increased need of irrigation water in the Southwest has created a serious concern over water shortages. The 1946 spring drought conditions aggravated this situation. More adequate water-yield forecasts are therefore of economic value. Research has produced further refinements in forecasts in such areas as the Salt River above Roosevelt Reservoir. Similarly, studies of soil moisture in relation to snow storage and melt indicate good prospects for improved forecasts in the Intermountain region.

The amount of fire protection to be given watershed forests in southern California has long been a matter of concern and dispute.

The California Forest and Range Experiment Station has recently developed a method of integrating possible effects of fire on erosion, flood flows, erratic seasonal stream flow, and the resultant damages from these factors. This method is now being applied to some 170 watershed units throughout southern California as a means of determining the intensity of protection from fire that should be given these areas. When completed, the study should provide a technique usable wherever watershed values are involved. It will also provide a method of measuring watershed damages due to fire.

Release of funds impounded during the war has permitted resumption of watershed flood-control surveys. The Secretary of Agriculture has assigned direct responsibilities for the surveys to the Forest Service or to the Soil Conservation Service largely on the basis of relative importance of the forest or agricultural land in the drainage basins as a source of floods or sediments. The two agencies work in close cooperation. First efforts are being directed toward completing reports on those watersheds on which work was under way when stopped by the war.

During the past year the first step was taken towards obtaining complete inventory of the water resources of forested lands on a national scale. Quantitative results thus far obtained substantiate our previous general knowledge of the heavy dependence of people, farms, and investments upon water supplies from forest areas.

RANGE RESEARCH

The 80 million acres of range land within the national forests are part of more than 900 million acres of native forage-producing lands, mostly in the 17 Western States and the South, from which come a major portion of our meat and wool production. The Forest Service's range research findings not only guide its range management on the national forests but provide essential information for stockmen and land managers to aid them in managing the forage resources on other public and private lands throughout this vast range country.

More than 600 million acres of western range are in need of improvement, and, of these, nearly 400 million are in need of major restoration. Complete restoration would practically double forage production, overcome much serious erosion, and stabilize the western range-livestock industry generally, and the many communities dependent on it.

In southern forest and wild lands the native forage has never been fully utilized. However, the sudden increase in livestock numbers on southern cut-over lands and coastal plains during the war, promiscuous, unguided burning in an effort to improve grazing conditions, and a great lack of knowledge of grazing capacity and grazing-management principles for southern ranges make it likely that some damage to forage production already has occurred, at least locally. In any case, it is certain that better use of these southern ranges can and should be made to maintain economical and efficient livestock production and provide better income and better living for the local people.

Better grazing and management practices developed through research are helping in the production of livestock in the South. Recog-

dition of the seasonal forage value of native range plants permits more efficient use and better correlation with improved pastures and farm-raised feeds. The use of prescribed burning and the appraisal of grazing capacity of cut-over and coastal-plains ranges also facilitate greater and more economical livestock production.

In the West, striking evidence of the value of conservative stocking has come from cattle- and sheep-grazing studies on experimental ranges. On the Manitou experimental range near Woodland Park, Colo., for example, yearling Hereford steers, grazed for a 5-month summer season at the conservative rate of 43 head per section, on good pine-bunchgrass range, gained 32 percent more than similar cattle under the usual heavy-stocking rate (56 head per section). Net income under conservative grazing was \$1,215 per section against only \$91 per section under heavy grazing.

While many depleted ranges can be restored to a high-production condition through improved management practices, millions of acres are so badly depleted that artificial reseeding holds the only promise of restoring satisfactory forage in a reasonable time. Research has now developed information to guide economical reseeding of abandoned cultivated land, depleted sagebrush range, logged or burned timber areas, and some other range types in the Intermountain and Northern Rocky Mountain regions.

Last year in Utah and southern Idaho more than half a million acres of depleted range were reseeded in accordance with the procedure developed by research. This will provide for carrying approximately 214,000 cattle or 892,000 sheep through the critical spring period, where only one-tenth this number could satisfactorily be carried before seeding. Large acreages were also successfully reseeded in Montana and other Western States at costs ranging from \$1.25 to \$3.50 per acre. Small-scale seedings by airplane in Utah and Montana were also successful.

Grazing trials on areas reseeded earlier demonstrated the value of such range restoration work. In Montana, yearling steers on range reseeded to crested wheatgrass gained two to three times more than similar cattle on native range conservatively stocked during a 140-day test period. In Utah, an area of 1,100 acres, reseeded to crested wheatgrass, now has a carrying capacity of $1\frac{1}{3}$ acres per cow-month, compared with 10 to 12 acres prior to reseeding.

Increased appropriations last year made possible the extension of research work on reseeding to all of the western range States, and on a more limited scale to several Southern States. This research includes tests of adaptability of a large number of species and varieties, classification of sites for reseeding, and experiments in seeding methods.

Grazing management and reseeding principles have been developed in a general way for many of the country's different range forage types and conditions. These broad guides will need to be refined and specifically adapted to each range area. Many large and important distinctive range areas have received little, if any, study. Even where research has been possible, many important problems have not yet been attacked.

Full application of known management principles, however, could go far to overcome range depletion and restore forage production. To

make best use of available information, a well-planned and coordinated extension program in cooperation with the Extension Service and other agencies is needed. This should aim, through demonstration areas and other means, to get research results into practice as rapidly as they are developed.

STUDIES IN FOREST ECONOMICS

Forest-economics studies during the war were devoted largely to the collection and interpretation of information needed by various government agencies in carrying out wartime policies. To aid in the reconversion program, some phases of this work were continued during 1946. In cooperation with the Civilian Production Administration and the Bureau of the Census, monthly surveys of lumber production and mill stocks were continued throughout the year. Reports on factors affecting production of lumber and other products were made at periodic intervals. Quarterly surveys of distributors' stocks, estimates of current lumber consumption, and forecasts of future requirements were prepared.

A number of special reports were made for the Office of Stabilization Administrator to appraise probable effects of price changes on the production of southern pine and Douglas-fir lumber. The postwar lumber situation in the United States, lumber-export policies, and other related problems were analyzed in reports and memoranda prepared for various congressional committees.

It is planned to continue these studies and surveys of production and requirements as long as needed during the reconversion period.

Under the McSweeney-McNary Act of 1928, the Forest Service has been conducting a Nation-wide forest survey. Approximately half of the country had been covered in the forest-inventory phase of the survey up to the beginning of World War II, when the work was largely suspended. As part of the reappraisal of the forest situation in 1945-46, survey data were carefully reviewed and brought up to date, and revised estimates were prepared for both surveyed and unsurveyed lands to show forest areas, quantity and quality of timber stands, growth and drain, and related information. The forest survey will be materially expanded during the coming year, with activities concentrated mainly in the Northeastern, Central States, and California regions.

The Forest Service hopes soon to be able to undertake an analysis of world forest resources in relation to United States timber supplies, timber requirements, and forest policies. With only 8 percent of the world's forest area, the United States has been consuming 40 to 50 percent of the world's timber cut, other than fuel wood. Prior to World War II we were on a net export basis for lumber, but at the same time we were dependent on other countries for more than half of the wood pulp and paper consumed. Now we are on a net import basis for lumber too. With world timber supplies dwindling, analysis of up-to-date forest information for all countries is greatly needed as a background for foreign-trade policies in forest products, and to aid the United States in cooperating effectively in world forestry programs.

TROPICAL FORESTRY

All Forest Service activities in Puerto Rico were placed under the single direction of a Tropical Forestry Unit in 1943. The unit supervises the Caribbean National Forest and maintains a tropical forest experiment station for systematic research in the management and regeneration of tropical forests. By appointment of the Commissioner of Agriculture and Commerce of Puerto Rico, the director of the unit also serves as Chief of the Insular Forest Service. This unified organization has proved advantageous in many ways. Federal and insular activities are under single, coordinated direction with no overlapping in functions. The combination results in lower general administrative costs for both the Federal and insular Governments.

The forests of Puerto Rico and their environmental factors are quite typical of the tropical forests elsewhere in the Caribbean area, Central America, and the northern half of South America. That fact makes the knowledge gained in managing and utilizing Puerto Rican forests applicable to those other far more vast and untouched forest areas of Latin America. Thus, the work of the Forest Service in Puerto Rico, both in forest administration and in research, is work in behalf of international tropical forestry also.

The Caribbean National Forest includes the original Luquillo Forest Reserve, established in 1903 from Spanish crown lands ceded to the United States by the Treaty of Paris; lands purchased in the Toro Negro Purchase Unit, established in 1934; and forest lands purchased by the Puerto Rico Reconstruction Administration that were transferred to the Department of Agriculture in 1943. The area under administration now totals 31,499 acres.

Because of the great population pressure on the land, every acre in Puerto Rico must be dedicated to its highest use. This is being carried to a refined degree on the Caribbean Forest. Opportunity is provided for many families to reside permanently in the forest, to raise some of all of their food crops, and to receive cash incomes from employment on forestry projects or from buying and processing small lots of timber and selling the product. These self-supporting people scattered through the forest fit extremely well the type of forest management in effect. The rapid growth of tropical forests and the sale of products in small lots enable the Forest Service to make selective cuttings and improvements as a recutting operation every 5 years or less, as contrasted to 25 or more years in many forests of the Temperate Zone. Revenue received by the United States Treasury during the past two fiscal years from sale of forest products and special uses exceeded the appropriations for protection and management of the Caribbean Forest. Being on a sustained-yield basis, this form of intensive and profitable forest management can be continuously maintained.

Four of the important hydroelectric and water-storage projects of the island use water from the Caribbean National Forest, and two new projects are ready for construction. Two areas of great scenic and health-giving value have been dedicated to public recreation.

The forest research program in Puerto Rico has progressed far enough to prove that the type of selective cutting now being practiced on the public forests is beneficial to both composition of stands and rate of timber growth. Much more needs to be known, however,

regarding which species to favor from the standpoint of their value to local people and industries and as a watershed-protection cover. An important series of studies has been on development of sound techniques for nursery practice, field planting, and plantation care. In addition, preliminary studies and tests have been made of the properties of some of the Puerto Rican woods, the uses to which they are most suited, and simple methods of preservation and processing.

The Tropical Forestry Unit's technical quarterly journal on forestry is distributed widely in the Caribbean and South American countries. A member of the staff is the chairman of the Subcommittee on Forestry of the Committee on Agriculture, Nutrition, Fisheries, and Forestry of the Caribbean Commission. The first meeting of the committee, at which all countries in that area except one were represented, was held in Trinidad in January 1946. As a result of that meeting a summary is being prepared of research in tropical forestry already accomplished or in progress and a comprehensive program of the tropical forest research still needed.

EMERGENCY RUBBER PROJECT

When Japanese conquests shut off foreign rubber supplies, Congress in the Emergency Rubber Act of 1942 called for a wartime project for domestic production of natural rubber. Major emphasis was given to planting guayule, a native rubber-bearing shrub which had been used for some years in Mexico as a source of commercial rubber. The Forest Service was assigned responsibility for the Emergency Rubber Project, with the Agricultural Research Administration cooperating on research phases. Nurseries were speedily established, acreage leased, and planting started. Most of the work was concentrated in California, where some experimental work in guayule planting had already been done by the Intercontinental Rubber Co.

While gradual liquidation of the Emergency Rubber Project had been under way since the decision was made in the fall of 1943 to do no more new planting, a quick final close-out of the project was called for by action of the Congress in the first supplemental surplus appropriation rescission bill, 1946, which required that complete liquidation be accomplished by December 31, 1946.

Before the close of the war, acting on the recommendations of a committee of representatives of rubber-tire manufacturers, plans had been developed by the Rubber Reserve Company and approved by the War Production Board to construct four new mill units and to mill out the rubber in existing guayule plantations as rapidly as possible for utilization of the rubber in the war effort. With the Japanese surrender it was anticipated that supplies of natural rubber from the Far East would be quickly forthcoming, and the construction of the four new mill units and the accelerated milling-out program were determined by Rubber Reserve and the War Production Board to be unnecessary. The mill already constructed at Bakersfield, Calif., and the Salinas, Calif., plant were operated on a more or less experimental basis on the young shrub then coming into maturity.

When complete liquidation of the project was decided upon in December 1945, the mills were shut down immediately. Assembly, inventory, classification, and disposal of all project property was

undertaken. Emphasis was given to the moving of surplus tractors and farm implements to aid in the expanded food-production program. Agreements were promptly entered into with landowners for the disposal of the shrub and reconditioning of the land.

Of the 32,000 acres of plantations established, shrub from less than 4,000 acres was milled out. A total of 2,947,273 pounds of guayule rubber was milled and sold to rubber companies during the life of the project.

On June 30, 90 percent of all project property had been declared surplus; all nurseries had been disposed of and the land returned to the owners; all labor camps transferred to other agencies or declared surplus. (Two labor camps on the Camp Pendleton Naval Reservation were in the process of being taken over by the Navy.) Final disposition of the property declared surplus is in the hands of the War Assets Administration.

Continuation of a program of guayule research was recommended by the Interagency Policy Committee on Rubber, but as no funds were made available for this work, the research program also was terminated June 30, 1946. However, proposals have been made to continue research on rubber-bearing plants under the auspices of the Army-Navy Munitions Board. Technical papers on research results so far obtained will be published by the cooperating bureaus. Since the project was terminated before most of the shrub reached maturity, many questions as to the possibilities of peacetime commercial production of guayule rubber in this country remain unanswered.

WORLD FORESTRY ORGANIZATION

The Forest Service is giving full cooperation to the Branch of Forestry and Forest Products established under the United Nations Food and Agriculture Organization.

World timber shortages that have been developing for centuries have now become a threat to reconstruction and to the higher standards of living sought by FAO. It is a truism that high living standards require an abundant use of wood. Supplying the wood needs of the world's people calls for purposeful and cooperative action on an international scale if world supply and demand are eventually to be brought into balance.

The Chief of the Forest Service has been named a member of the standing advisory committee of the FAO Forestry Branch. The organization plans to set up international forestry statistical services, assist governments with advice on forest policy, send out missions to make scientific studies, promote research and circulate findings among nations, and facilitate exchange of scientific personnel.

The scope of the forestry job facing the various United Nations is suggested in a list of major problems set forth by the international committee of foresters and scientists that prepared the way for establishment of the FAO Forestry Branch. Among these problems were: Restoration of Europe's war-depleted forests; extension of sound forest management in countries whose reserves of old-growth timber are being depleted; afforestation in regions where forests have been partly or wholly destroyed; initiation of forestry measures in

the largely unexploited wood-surplus countries; effective world distribution of forest products; world-wide correlation of results of forest research; coordination of forest production and utilization with soil, water, and wildlife conservation and grazing.

FOREST SERVICE PERSONNEL

With the cessation of hostilities the Forest Service was faced with its own reconversion problems, which posed many difficulties in the reemployment and reassignment of personnel. There were not only the returning veterans but many employees who had been transferred to various war agencies or to various temporary wartime activities and projects of the Forest Service which were later curtailed or closed out.

During the war the number of Forest Service personnel who served in the armed forces reached 2,034; and of these 39 were killed or missing in action. Nearly 1,000 had returned to the Forest Service by June 30, 1946, and only 27 specifically stated their intention not to exercise their reemployment rights. The Forest Service has welcomed these veterans back. It has been possible to reemploy many of them with well-deserved promotions, and every effort will be made to assign others to a place in the Service commensurate with their abilities as readjustments are worked out.

Full recognition should be given, too, to the loyalty and devotion with which those employees who did not go into military service performed their work—closing the ranks behind those who left and assuming increased work loads and activities with energy and resourcefulness. Only their unflagging zeal and long hours under severe handicaps kept much of the work going.

Ninety-five Forest Service employees retired during the year. They averaged more than 29 years' service. A number had worked longer on the job than their personal preferences dictated because of a desire to help during the war.

During the year the Forest Service cooperated with the War Department by furnishing five technical employees to assist in organizing the forestry phases of the occupation of Japan and Korea. One forester was made available to administer the civilian forestry organization of the American zone in occupied Germany.

The Forest Service, because of war conditions, had a deficit of new technical employees in the lower grades. At the close of the fiscal year, arrangements had been completed with the Civil Service Commission for holding both assembled and nonassembled examinations to provide for the recruitment of new technical personnel. With relaxing of some of the pressure and the manpower shortage of the war years, the Service is looking forward to much more adequate orientation and training of these prospective new employees. Experience with psychometric testing of employees has shown that it has considerable promise and reliability. A more intensive use of this means is contemplated for better placement and reassignments for the broadening of career-employee training experience, as well as for more adequate appraisals of employees during their probational appointment.

RECEIPTS AND EXPENDITURES

Receipts from the national forests during the fiscal year 1946 totaled \$13,875,091. Of this amount \$10,554,332 was received from the sale of timber; \$2,059,676 from the use of forage; and \$1,261,083 from special land uses, water power, etc. Distribution of receipts was as follows:

Returned to States in which national forests are located as required by law \$3,463,769; amount appropriated for expenditure by the Forest Service for (a) roads and trails on national-forest lands \$1,369,774; and (b) acquisition of national-forest lands \$138,017; balance returned to United States Treasury \$8,903,531.

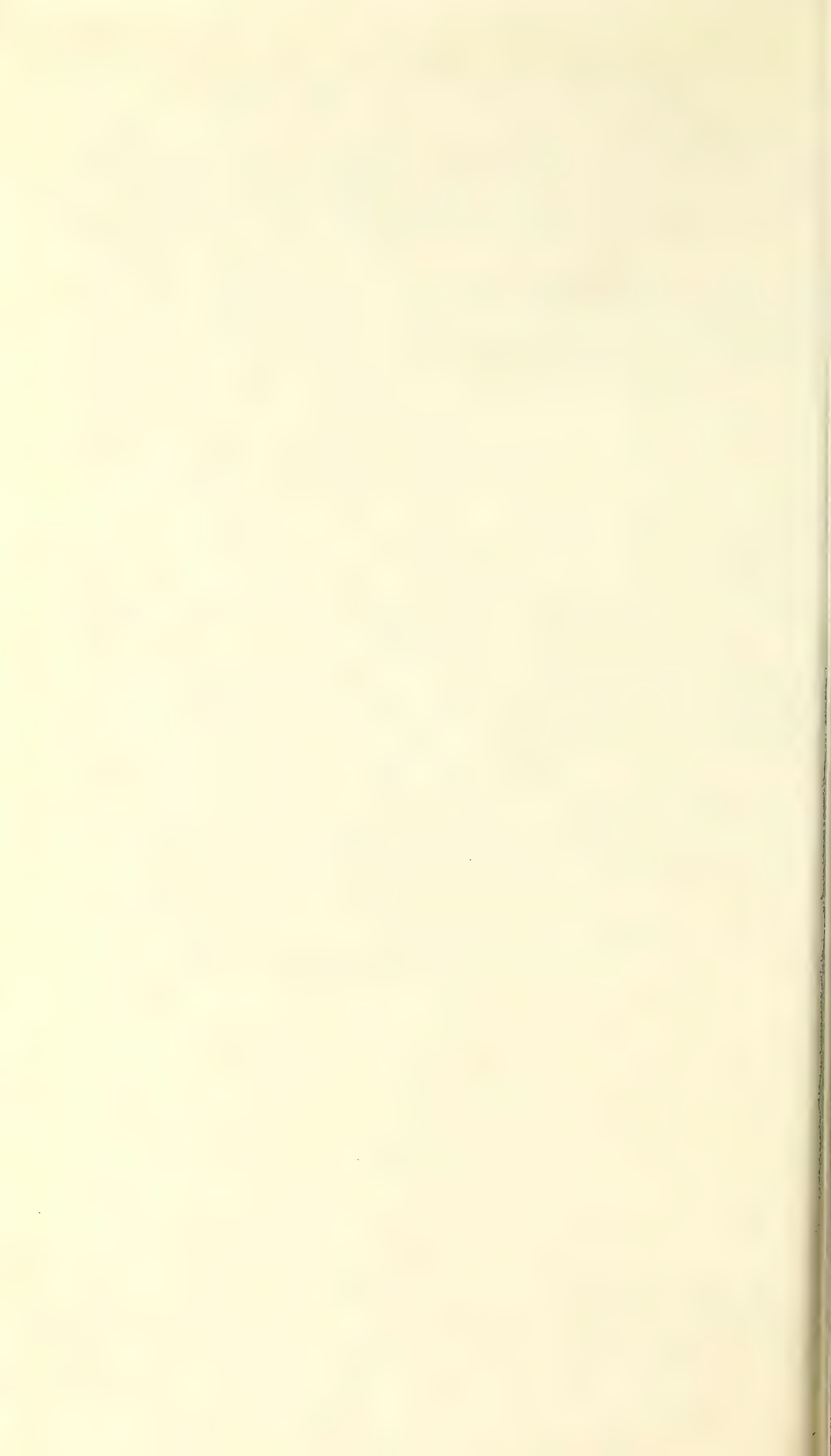
Expenditures for the national forests aggregated \$32,624,609, of which \$8,070,859 was from appropriations for forest roads and trails; \$679 for acquisition of land. The balance, \$24,553,071 was for protection, development, and management.

Other Forest Service expenditures included cooperation with States and private agencies in fire control, planting and forest practice, \$7,960,138; contributions from outside sources for fire control, slash disposal, improvement work, etc., \$2,685,509; research, \$3,083,799; flood control, \$346,237; general administrative expense, \$613,585; Emergency Rubber Project, \$2,631,463; and expenditures from proceeds of sale of parts and equipment, \$362,488.

Services for other Government agencies involved expenditures of \$2,788,173, including \$925,039 for the Civilian Production Administration; \$549,112 for the Army; \$377,873 for the Navy; \$269,126 for the Public Roads Administration; \$361,091 for the Selective Service System; and \$305,932 for other agencies.

Total net expenditures were \$53,096,001. In addition, expenditures for which appropriations were reimbursed amounted to \$5,163,239, so that gross expenditures by the Forest Service for the fiscal year 1946 were \$58,259,240. These expenditures were accounted for by objective and functional classifications under 112 separate appropriation titles.

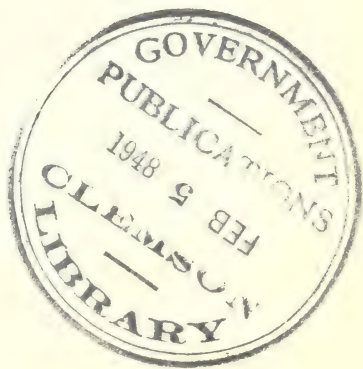
The Forest Service was also responsible for the naval stores conservation program, involving payment of \$672,869 from funds of the Production and Marketing Administration.



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REPORT
of the
Chief of the Forest Service
1947

Forests and the Nation's Water Resource



UNITED STATES DEPARTMENT OF AGRICULTURE

U. S. DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., September 18, 1947.

HON. CLINTON P. ANDERSON,
Secretary of Agriculture.

DEAR MR. SECRETARY: In addition to reviewing the work and accomplishments of the Forest Service during the past year, I have devoted some space in this report to a discussion of our watershed situation and its implications in terms of public welfare. Watershed problems have been mentioned in earlier reports. They need special emphasis.

Muddy streams, dried-up springs, lowered water tables, eroding lands and reservoirs filling with silt, damaging floods every year—all these things are plain indications that much watershed land is not being handled as it should be.

Conservation of water is of the utmost importance. Lack of enough water can limit the growth of communities, industries, agriculture. Floods—too much water in the wrong places—can cause terrible damage and loss.

In the report for 1946 I called special attention to the serious downward trend of this country's timber resource. It is important that the public also be fully informed as to the equally serious watershed situation. It is no exaggeration to say that our Nation will decline if its resources decline. Timber and water are basic resources. The protection and management of our forest lands have far-reaching influences on stream flow and water resources.

The Forest Service program is to conserve, restore, create, build up. We of the Forest Service are working hard to build up and properly manage the resources of the national forests for which we are directly responsible, and to promote the sound management and wise use of all forest and wild lands. But the Forest Service cannot do the whole job alone. It must have the cooperation and support of the public, and that support should be based on a knowledge and understanding of the facts.

Sincerely,

Lyle F. Watts

LYLE F. WATTS
Chief, Forest Service.

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FORESTS AND THE NATION'S WATER RESOURCE

WATERSHED PROTECTION IS VITAL

My annual report last year called attention to a growing shortage of good timber in the United States. It pointed out that our forests were not producing as much saw timber as we needed currently; that they were growing far less than we are likely to want in the future. It suggested measures to increase timber growth and eventually achieve timber abundance.

The situation today remains essentially unchanged. We are still taking more saw timber from our forests than is replaced by growth. We still face a growing scarcity of forest products. And time is passing.

Timber production is vital to our national economy, but it is by no means the only useful function of our forests. The forests harbor a valuable wildlife resource. Their recreational values contribute greatly to our physical and spiritual health. Forest ranges have an important part in national livestock production.

But undoubtedly the paramount service of a very large part of our forest land is as a source of water, an erosion preventive, and a regulator of stream flow. Irrigation agriculture, hydroelectric power development, municipal water systems all depend on adequate and reliable water supplies. Good management of forest and range watersheds can reduce the danger of disastrous floods. We need clear, clean streams from protected watersheds for good fishing and other outdoor sports. Water supply determines the establishment of homes, farms, industries; communities develop only where water is available. An assured, dependable water supply is indeed essential to our State, regional, and national development. Water is an essential of life itself.

In this year's report I should like to give special attention to our forest and wild-land watersheds. There are some encouraging things to report, but the story as a whole is not a pleasant one. Many important watersheds are in critical condition. Much watershed land is not adequately protected. We are paying a huge price every year—in heavy flood losses, erratic stream behavior, reduced water quality, sedimentation, and in many other ways—for our failure to give enough care to the highlands that water our valleys.

This watershed situation is nothing new or sudden. In many places it has been worsening for years along with the decline of our timber and range resources, and to a considerable extent from the same causes. But it is time we faced this problem in its full significance.

Damaged watersheds can be repaired. Rampaging streams can be brought under control. Water sources can be kept in good condition. And to a large extent the kind of forest and range management that restores and maintains good watershed conditions will also make for increased timber supplies and increased livestock production. Recreation and wildlife also will benefit.

MANY WATERSHEDS ARE IN POOR CONDITION

It is not necessary to look far to see evidence of poor watershed conditions. For instance:

Muddy streams.—The water that comes as rain or snow from the heavens is not muddy water. Mud in the streams comes from the land. Muddy streams mean that soil is eroding from watersheds.

The Potomac River, which flows by the Nation's Capital, is a stream that once ran clear but is now characteristically muddy. So are the Lehigh River, the Coosa, the Trinity, the Illinois, and the Platte. So are hundreds of other streams throughout the country.

The Potomac River, during 5 days of the April 1937 flood, carried an estimated 2,210,000 tons of suspended matter—mud—past the Fourteenth Street Bridge at Washington, D. C. Once clear Ozark mountain streams, such as the St. Francis, the Meramec, and the White Rivers, now run muddy and carry quantities of damaging sediments. This is true also of the Upper Mississippi and many of its tributaries. Jesuit missionary explorers told of the placid waters of the Ohio that flowed clear as crystal. The records of early river travelers tell of its exceptional clearness and purity. Today the Ohio is murky, carries a heavy silt burden, defiled with mining and industrial wastes and the sewage of dozens of towns and cities from its headwaters to the Mississippi.

The Colorado River carries a tremendous load of silt, and there can be little doubt that the silt burden increased after the West was settled. The Missouri River has probably been muddy for centuries because of sediment from poorly vegetated areas and badlands. It was called the "Big Muddy" by early-day settlers. It is living up to its pioneer name with an even greater silt load today.

Flash floods.—In May 1947 a flash flood took the life of a child, and deposited rocks and debris in the streets of Manitou Springs, Colo. In June 1947 a flash flood took several lives and damaged crops at The Dalles, Oreg. A flash flood hit Wilkesboro, N. C., in June. At Bradford, Pa., a flood in April—the third since 1942—caused estimated damage of \$3,000,000.

These are just a few examples of the year's total of small but damaging headwater floods which rushed down on communities or farm lands, suddenly and without warning. In most cases, the direct relation of the flood to the condition of the soil and vegetative cover on the watershed can readily be ascertained.

The town of Mount Pleasant, Utah, experienced a flash flood in 1946 which caused more than \$100,000 damage. The flood came from a small portion of a 10,000-acre drainage on which overgrazing by livestock had depleted the vegetative cover and compacted the soil. In 1945 Salt Lake City suffered a loss of \$350,000 from a summer flood which poured down from a small watershed area near the city. Virtually all of the flood came from about 600 acres of grassland that had been swept by fire the year before. On portions of this burned area soil was washed off to a depth of 10 inches in a matter of minutes. On islands of grass the fire had skipped, there was no sign of surface runoff or soil loss.

In Los Angeles County, California, on New Year's Day, 1934, a flood ripped out of Pickens Canyon, destroyed 400 homes in the town

of Montrose, caused \$5,000,000 damage, and took 34 lives. About a month earlier, a forest and brush fire had burned over the watershed area above the canyon. Heavy rains occurred over the whole mountain area, but it was from the few hundred acres of burned watershed above Pickens Canyon and only from that burned-over watershed, that damaging flood waters came.

People often attribute these flash floods to "cloudbursts." But if the watershed is in poor condition, relatively small rainstorms may be the "cloudbursts" that cause floods. And much heavier rains may fall on well-protected watershed lands without causing flood runoff.

On Ford Canyon watershed in Davis County, Utah, a 1934 storm of less than one-half inch rainfall produced enough surface runoff to carry boulders 9 feet thick out of the mouth of the canyon. This flood came from the north fork of the canyon. From the south fork, where watershed repair work was then almost completed, no storm flow came.

As watershed deterioration progresses, less and less rainfall is needed to produce surface runoff of flood proportions. You may call these floods "Acts of God," but it is usually man's misuse of the land that intensifies them.

Big river floods.—Flood waters from the Mississippi and Missouri Rivers in June 1947 inundated hundreds of thousands of acres of farm land, drove thousands from their homes, disrupted power, communication, and transportation systems, and caused hundreds of millions of dollars' worth of damage. This has become a tragically familiar, recurring story in the Mississippi Valley. In the past 35 years the Mississippi has overflowed its banks 11 times.

Big, damaging floods are occurring with increasing frequency in the United States. A list of the "most disastrous floods and inundations" of historical record in the *Encyclopedia Americana* includes 17 great disasters in North America since Columbus discovered the Western Hemisphere. All but 4 of these occurred since 1900.

Flood records at Pittsburgh, Pa., go back to 1806. In the 67-year period from 1806 to 1873, the Youghiogheny River flooded 22 times. In the next 65 years (1873–1937) it flooded 81 times.

On the French Broad River in North Carolina the average number of floods per year increased from 0.4 in the period from 1875 to 1899 to 1.1 in the 1925–40 period.

When the Willamette River in Oregon flooded in December 1945, higher stages were reported at several stream-gaging stations than any previously recorded.

Similar stories can be told for nearly all of our major rivers. Since the turn of the century, major floods have occurred on the Connecticut River, the Choctawhatchee, the Delaware, the Brazos, the Rio Grande, the Yazoo, and many others. The flood record quite consistently reflects the story of what has happened on the watersheds and the significance of these happenings in terms of runoff and erosion.

Sedimentation.—When the soil washed from eroding lands comes to rest it can be a costly public nuisance. It can clog the streams and cause floods; it can hinder navigation, fill harbor channels with mud. It can clog irrigation ditches and canals. It can ruin good farm land. It can cause tremendous expense for its removal from highways, railroad lines, and urban properties where it is deposited. It can spoil the

recreational value of many waters. It can ruin fishing—destroy the fish food on stream bottoms, cover the fish eggs, make the water unsuitable or actually uninhabitable. It can fill water-power, irrigation, and domestic water supply reservoirs with silt, shortening their working life and eventually making them useless. It can greatly increase the cost of making water fit for drinking or industrial use. It is doing all these things in our country.

The average annual damage caused by sedimentation of irrigation canals and ditches in the Boise Valley of Idaho has been estimated at around \$350,000. At Minersville, Utah, the main irrigation canal was filled with debris from upstream sources six times in a single season. It cost the community many thousand dollars in crop failures, and irrigation assessments were increased 500 percent.

Many irrigation enterprises in the West, particularly the smaller ones, are in difficulty year after year because, with declining summer flows, sediment deposits at the dams or canal heads prevent water from entering the canals. In some places silt has damaged soil by sealing it against the percolation of irrigation water.

Large areas of once rich and fertile bottom land in Eastern States have been buried under heavy deposits of infertile sediment.

Mud deposits in the big rivers constantly raise the level of the stream beds, making necessary higher and higher levees as a defense against floods, or costly dredging to keep channels open for navigation. At some points in the Mississippi Delta the river contained by the levees is higher than the adjoining land.

Along the middle Rio Grande some 80,000 acres have been made unfit for farming, on account of waterlogging that resulted from silting in the main river channel and a corresponding rise of old canals and ditches to levels above those of bordering lands. Similar conditions exist along portions of such streams as the Yazoo, the St. Francis, the White, and many others.

Siltation from eroding lands is largely responsible for heavy dredging costs to maintain navigation channels and port facilities on the Delaware and other northeastern rivers. Long stretches of the Missouri are no longer navigable. At one time all the major streams of the East Gulf drainage were much used for navigation. Many have changed from clear streams with good channels to muddy, shallow ones obstructed by logs and drifts.

Sediment washed down from the watersheds is reducing the water-storage capacity or threatening the life of many of the reservoirs on which we depend for municipal water supplies, hydroelectric power, or irrigation. Several years ago a national survey indicated that 40 percent of all the reservoirs in this country would be filled with silt in less than 50 years. In the Southeast, a number of the smaller water storage reservoirs have completely silted up and have been abandoned.

The life of the great and costly Hoover Dam on the Colorado River is threatened by silt. In 1945 it was estimated that at the present rate of sedimentation the capacity of the reservoir (Lake Mead) will have been so reduced by silt in about 37 more years that its usefulness will from then on decline. That will mean that the flood protection provided by Lake Mead will gradually disappear, that large areas of irrigated land will eventually go out of cultivation, that power output will be reduced, and that business and industry dependent on these power and water resources will decline.

The number of reservoir sites in this country is definitely limited.

Wherever displaced soil may be found—as mud flats, sand bars, debris on farms, or silt deposits in reservoirs—it indicates mistreatment of lands on the watersheds.

Water-supply problems.—Many people do not realize that water shortages actually exist in this land of ours, and that mismanagement of watershed lands has contributed to the deficiency.

Water tables are going down. Usefully available water supplies are becoming inadequate in many areas. Tremendously expensive diversions of water are being made to relieve shortages in urban and rural areas, such as the transfer of Colorado River water to Los Angeles, and of water from the Sacramento River to the San Joaquin Valley. As needs increase, many cities are having to reach out still farther to obtain water at ever-increasing cost.

Water supply is the limiting factor in the development of most sections of the West. It is becoming so in parts of the East as well. While impoverishment of the watershed resource continues, increasing population and greater per capita consumption are bringing additional pressure for water supplies for municipal uses, for power, agriculture, and industry. In some places the limits of expansion already have been reached.

Because it contains silt, much of our stream water has to be treated before it can be used for domestic purposes and for many industrial purposes. The cost of treatment runs high. A study made a few years ago showed that costs of water treatment for 22 cities in the Piedmont area of North Carolina averaged \$27 per million gallons. The watershed areas were about 50 percent forested. At Asheville, N. C., where all of the watershed is in forest, water treatment costs were about \$8.50 per million gallons.

All these things mean that lack of adequate watershed management is costing the people of this country untold millions in hard cash every year. More than that, it is undermining the very foundations of our economic life. On some mountainsides, erosion gullies already have eaten down to bedrock. You can't raise meat or lumber on bedrock. In some places silt deposits from the muddy waters have driven agriculture from rich bottom lands up to the less productive hillsides, where cultivation often further speeds up the processes of erosion.

A geologic period of tremendous erosion followed the retreat of the glaciers at the end of the Ice Age. It took thousands of years for the stream courses to become stabilized and the earth to be anchored in place by trees and grass. Good soil was formed by the weathering of rock and the deposition of organic matter from vegetation. The land became rich and good for human habitation. Only in a few areas such as the breaks of the Missouri River, the badlands of the Dakotas, and parts of the Colorado basin, were climatic and geologic conditions so unfavorable as to prevent stabilizing the land surface by soil formation and plant growth.

Good lands elsewhere can become badlands. A new period of erosion is now under way in this country as great if not greater than any that has occurred since the glacial epoch. And this one is man-made.

HOW FOREST AND RANGE TREATMENT AFFECTS WATERSHEDS

Trees, brush, grass and their litter protect the soil. The full force of the beating rains is broken by the vegetation. Some moisture is intercepted by the foliage and later returns to the atmosphere through evaporation. The water that reaches the ground is filtered through the plant litter and spongy humus of the forest floor, and percolates gently into the porous, receptive soil below. Some of this water is subsequently taken up by the vegetation in its life processes. That portion of it not needed for plant growth seeps through the soil to underground water reservoirs or channels which feed wells and springs. Many good forest- or grass-covered soils absorb water so readily that surface runoff seldom occurs. Even when it does occur, the soil is so firmly anchored by a tangle of roots that little soil is washed away.

Snow melt is more gradual under the forest canopy. The forest soil is less subject to deep or solid freezing. Thus when field and pasture soils may be frozen so solidly that no water can infiltrate, the loose, humus-enriched forest soil is open and receptive.

When vegetative cover and litter is lacking, soil is exposed to the full striking force of rain. The hammering raindrops splash the soil particles about, the finer particles sealing the surface against the entry of water. Bare soils, especially those with a high clay content, are hardened by alternate rainfall and sun baking. They absorb water very slowly. The excess runoff from hard rains may be extremely rapid. The water running downhill eats into the soil and carries great quantities of it away. Under some conditions surface runoff may carry so much soil as to result in mud flows and movement of boulders weighing many tons.

Surface runoff not only removes topsoil in sheets, but eats into the subsoil, gullyng the slopes. With each succeeding heavy rain the gullies grow larger, and the runoff more rapid. In southwestern Tennessee and northern Mississippi gullies that started only a few years ago have grown so wide and deep that whole houses and barns could be pushed into them. Man-made badlands can be found in the eroded uplands of the Yazoo, the ruined Ducktown Basin of Tennessee, the gullied Piedmont areas of the Southeast, the gullied lands of southwestern Wisconsin, the expanding arroyos of the Puerco in New Mexico, the placer-mined areas in California.

Research is giving definite information concerning the ability of soils to absorb water under varying watershed conditions. On the Potomac watershed, shaley silt loams in good forests took up as much as 4 inches of rain water per hour. Similar silt loams in burned and grazed woodland were able to take up less than an inch of water per hour. Sample areas in Mississippi were checked during a rainy period and it was found that 62 percent of the rainfall ran off from cleared lands; from adjoining forest land, less than one-half of 1 percent. The cleared lands lost 34 tons of soil per acre; from the forest land no measurable quantity of soil was washed away.

Good forest cover, with its undergrowth, litter, and humus, affords the most effective watershed protection. Shrub or grass cover in the drier portions of the West also perform vital watershed protection services. The brush or chaparral that covers much of the mountain

country of southern California, although of little value in itself, is important in conserving water supplies and lessening or preventing flood and debris flows. The grassy vegetation of the open ranges is of vital importance for watershed protection over large areas of the West.

Runoff studies were made recently on comparable plots of western range land. Where 60 to 75 percent of the ground was covered with plants and litter, water runoff was 2 percent of the amount of rain falling per hour; soil loss amounted to only 0.05 ton per acre per hour. On a plot with only 10 percent of the ground covered with plants and litter, 75 percent of the rain ran off per hour, and 5.55 tons of soil was washed away per hour from each acre. The denser ground cover was thus over 36 times more effective in halting water runoff and over 100 times more effective in halting soil loss than the poorer ground cover.

Vegetative cover on the watersheds cannot prevent all floods. With prolonged heavy rains, the best of absorptive soil may not always be able to take up all the water that comes down. But it will have absorbed vast quantities that would otherwise have poured into the streams. And the vegetative cover will have slowed down the runoff of the remainder. This is often enough to keep runoff below flood levels. Even if floods come, it may be enough to keep flood crests below the danger point. The more water we can store in the soil the lower will be the stages of flooding streams.

In parts of the West where water is scarce, some people have had the idea that removal of vegetative cover on the watersheds would be desirable, because a bare watershed, like a tin roof, would produce more water to fill the irrigation reservoirs. Bare watersheds certainly would produce quicker surface runoff—but the soil would be unprotected against erosion; the runoff would carry damaging sediments; mud as well as water would pour into the reservoirs. Any improvements or developments in the drainage area would be subject to damage by flash floods. The economic value of the watershed lands for grazing or timber production would be destroyed. Also, much farm land in the West is irrigated by water pumped from wells. The water in those wells comes largely from mountain watersheds where vegetative cover promotes absorption of water into the ground. The more water that runs off the surface, the less there is available for replenishing underground supplies, and the greater the likelihood of wells going dry.

Repeated fires have ruined the forest cover on many watershed lands in the East and South. In the West, forest growth on watershed lands often is razed by a single roaring blaze.

Too heavy cutting of timber may also damage watersheds. Wind and sun dissipate the exposed litter on the ground, robbing the soil of its protection and its essential food supply, and destroying soil-building organisms. Skid trails, down which the logs are dragged to the loading decks, often gouge out channels for rapid runoff and erosion.

In road construction in hilly or mountainous country, the raw soil exposed in road banks and cuts and fills is subject to rapid erosion. Too often the road scars are left to heal by themselves if they will. If they erode, as most of them are bound to do, expensive control measures become necessary.

In hardwood forests of the Central, Eastern, and Southern States too heavy grazing by livestock causes damage to watersheds. Cattle browse and destroy small trees and undergrowth. Their trampling compacts the woodland soil so that it will soak up less rain. Such soils also freeze more deeply, and spring runoff is increased.

Overgrazing or poorly managed grazing has seriously damaged millions of acres of watershed range lands in the Western States. If too many cattle or sheep are allowed on the range they graze the forage too closely. They trample to dust areas where they concentrate. Vegetation becomes sparse; erosion increases, hastening the deterioration of the range. Heavy grazing, and, to some extent, range fires in the West have killed out choice perennial grasses with wide-spreading root systems and caused their replacement by small-rooted annual grasses and weeds which not only are less effective in preventing soil erosion and destructive runoff but are low in forage value. Often stock are turned on the range too early in the spring, while the soil is still wet from snow melt and the grass is not dense enough to withstand grazing.

Indications of damage to watersheds are easy to find. Exposed roots of trees, shrubs, and grasses mean that erosion is well under way. On many western ranges you can see bunches of grass whose root crowns stand several inches above the ground surface. That means several inches of soil have washed away within the lifetime of those individual grass plants. You can see "soil pedestals"—where small stones have been left standing on little pedestals of soil as the surrounding soil washed away. You can see "rock paving," where soil particles have gone with the wind or rain and left a gravel-covered ground surface. In almost any section of the country you can see hillsides covered with "shoestring gullies," as if some gigantic beast had scratched the land with its claws. You can see where tiny shoestring gullies have grown into great gashes in the land, down which water rushes in a muddy torrent after every heavy rain.

Generally the wild lands at higher elevations are the key watersheds. These are the lands at the headwaters of our major rivers. The higher lands usually receive the most precipitation, especially in the West. In many sections of the Western States, valley and foothill lands receive an average of only 15 to 20 inches of rainfall a year, while at higher elevations precipitation averages 40 to 50 inches or more yearly. Two-thirds of all the land of the Southwestern, Intermountain, and western Plains States receives, in fact, less than 15 inches of rain annually. Fifteen inches of rain is not enough to thrive on without supplemental water sources; water sometimes evaporates from the ground surface at as fast a rate as that. So the high country—the mountain watersheds—must sustain life in all this area.

The high country of the West is for the most part forest and range land. Most of the higher watershed lands of the East are forest land. It is of the utmost importance that these forest and range lands be handled with full consideration of their watershed values. These values undoubtedly exceed those of all the direct cash products the lands can yield. They are fundamental to the life of the Nation.

NATIONAL-FOREST WATERSHEDS

Watershed protection was one of the major purposes in the creation of the national-forest system from public domain lands more than half a century ago. It was largely concern over watershed conditions that led to enactment of the Weeks law of 1911 authorizing Federal purchase of lands for national-forest purposes.

Virtually all of our national forests are sources of water of the highest importance for industrial, agricultural, domestic, and recreational use. National forests west of the Great Plains include many of the high-altitude areas that are the source of 90 percent of the water of the Western States. The watershed services of national-forest lands at the sources of western rivers transcend all other values attached to these lands. There is no substitute for these services.

The great Central Valley of California is a highly developed area only because of the water supplies available from the adjacent mountain watersheds of the Sierra and north coast ranges, which are largely in national forests. Southern California has been reclaimed from a semidesert condition and is maintained as a center of population by water resources that originate to a great extent in national forests of the southern coastal range, the Sierra, and the Rocky Mountains. National-forest watersheds of the Cascades and northern Rockies are major sources of the Columbia River. The agricultural, industrial, and urban economy of Utah depends on the water resources of the Wasatch Mountains, largely within national forests. In Arizona and New Mexico, national forests occupy the high elevations in which the major water supplies originate.

In the more humid East, the national forests are as yet too small and too scattered to contribute so overwhelmingly to regional water supplies. But here, too, national forests stretch across some of the high water-yielding areas of the Appalachians and the Ozarks; they include the headwaters of many coastal and interior streams, supply many communities and industries with water, and provide much healthful recreation associated with clear streams and lakes.

More than a thousand cities and towns obtain all or most of their water from national-forest watersheds. They include such cities as Denver, Albuquerque, Phoenix, Ogden, Little Rock, Los Angeles, and Portland. Some 21 million acres under irrigation in the 17 Western States depend almost wholly on water from national-forest watersheds. More than 400 water-power projects are in operation or under construction within the boundaries of national forests.

National-forest waters have important recreational values, also. The 90,000 miles of streams within the national forests provide some of the best fishing in the United States. The suitability of streams for fish life depends on the maintenance of watershed cover adequate to prevent severe disturbances of fish habitat by silt accumulations and great fluctuations in stream flow.

The Forest Service, as custodian of the national forests, clearly has a direct responsibility in watershed management on lands within its own jurisdiction.

The Special Problems of the Ranges

The national forests administered by the Forest Service include more than 80 million acres of land suitable for livestock grazing.

Most of this is in the Western States, and most of it is highly important watershed land.

Long before the national forests were established, most of these forest ranges were being used by livestock. The lands were then part of the unreserved public domain, and grazing on public domain lands was unrestricted. Stockmen fought to get to the best grass. When the national forests were established many of the forest ranges already were badly overgrazed and deteriorated. Overstocking during World War I, and prolonged droughts, accentuated range deterioration on many allotments.

Over the years, the Forest Service has endeavored to bring grazing use into balance with sustained range capacity. Much progress has been made; some more remains to be done. This must be done not only to maintain the growth of forage for livestock, but to protect watersheds upon which many western irrigation, power, and city water supply projects depend.

Mindful of the grazing permittees' dependence on use of national-forest range and of the effect that drastic reductions might have on the ranchers' incomes, forest officers moved slowly in reducing permitted numbers of livestock. As a result, reductions in livestock numbers have not offset the cumulative effects of overgrazing on many ranges.

About half of the individual and community ranges on the national forests need further corrective action of one kind or another to check erosion, protect watersheds, and bring the ranges back to fully productive condition. Forest Service efforts to relieve overgrazed ranges are not confined to reductions in livestock numbers alone. In some cases better distribution and management of stock on the range, or improvements (fences, water developments, etc.) to facilitate management will help. Reseeding of depleted ranges, as well as reduction of rodents and poisonous plants which prevent full use of some ranges, is being pushed as rapidly as funds become available.

Where reductions in livestock numbers must be made, it is the policy of the Forest Service to give the affected permittee ample notice, discuss the matter with him, and afford him a chance to ride the range with the local forest officer and check conditions on the ground. If a heavy cut is necessary, it is spread over several years in order to cause as little hardship to the permittee as possible and to give him the opportunity gradually to adjust his operation. No blanket reductions are made; in each case the adjustment is determined by the condition of the soil and vegetation on the specific range allotment. Reductions in total numbers of livestock have never been excessive for any one year. During the past 5 years they have averaged about 2½ percent per year.

Most of the permittees cooperate in this adjustment program. They recognize the need for remedial measures. But a small segment of the livestock industry has hotly resisted these adjustments. They have charged the Forest Service with arbitrary and dictatorial methods, and with attempting to exclude all livestock from the national forests. They have proposed various measures to restrict the Forest Service in its management of national-forest range lands and to put greater control of grazing use in the hands of the present permittees.

Definitely and positively the Forest Service does not seek to exclude all livestock from the national forests. On the contrary, the program of the Forest Service looks to building up and maintaining the national-forest ranges so that they can make their maximum contribution to a permanent and stable livestock industry, consistent with the protection of watershed and other values and uses of the range. The national forests are administered for public benefit and use, and grazing is a suitable and productive use for large areas of national-forest lands. At the same time, the Forest Service is responsible for protecting the interests of the thousands of water users, recreationists, and others who have a vital stake in these same lands.

The Forest Service believes that its program is in the best long-term interests of the livestock industry itself. Certainly the livestock industry will suffer if the ranges continue to deteriorate. And irrigation farmers and other water users will suffer as well.

When the national forests were placed under Forest Service administration in 1905, the guiding principle laid down was that all national-forest land "is to be devoted to its most productive use for the permanent good of the whole people, and not for the temporary benefit of individuals or companies * * * and where conflicting interests must be reconciled the question will always be decided from the standpoint of the greatest good of the greatest number in the long run."

In line with this principle, the Forest Service has administered, and is administering, the national forests under a system of "multiple use." Multiple-use management is management for the coordinated maintenance and use of all forest resources and values. It looks to the development, protection, and sustained use of natural units of land under correlated, long-term management plans, rather than the utilization of a single resource in possible conflict with, or at the expense of, other resources on the same area. Within a management unit, one use may be dominant in one portion, and another use dominant in another portion. Recreation may be the highest use, for example, on areas adjacent to streams or lakes, timber cropping on the slopes, and livestock grazing on the intermingled "parks" and ranges. The whole area may be an important watershed. Under multiple-use management, all these uses are coordinated, and conflicts adjusted, for the entire management unit.

Under the multiple-use system, grazing, like other uses, is permitted and encouraged in the national forests where the land is suited for it and it does not jeopardize other important values. But much of the land grazed is extremely important watershed. Much of the grazing, too, is on land supporting commercial timber.

Any proposal that would restrict or hamper effective administration and management of national forest-lands used as range for livestock, therefore, ignores the interests of irrigation farmers, residents of valley communities, recreationists, sportsmen, and others. It would subject the lands to the possibility of the same kind of misuse that originally caused them to be included in the national forests.

Many stockmen oppose these proposals to restrict or undermine national-forest range management. The Forest Service has received letters or resolutions from more than 30 State and local livestockmen's associations and from many individual livestock permittees expressing confidence in and support for the Forest Service range program. Strong support also has been given by other groups vitally interested

in the various resources of the national forests. The Idaho State Legislature passed a resolution upholding the integrity of national forests, and more than 100 resolutions supporting Forest Service policies were adopted during 1947 by chambers of commerce, farm organizations, irrigation ranchers' and water users' associations, labor organizations, dude ranchers, sportsmen's groups, and conservation associations.

In contrast to the proposals of some stockmen's groups, Weber County, Utah, in 1947 organized a Watershed Protective Corporation for the purpose of receiving "donations from municipal or private corporations or interested individuals in order to purchase, acquire and bargain for lands in the county having value as watersheds and * * * to transfer them to the United States to the end that the natural resources and watersheds might best be conserved and thereby provide to the inhabitants and communities of the county a more secure and abundant water supply."

Previously, several counties in Utah, Nevada, and California had voluntarily moved to forego their share of national-forest receipts in order that these funds might be used to purchase additional watershed lands to be included in national forests.

Other Range Lands Present Similar Problems

The 80 million acres of national-forest range is but a small part of the 728 million acres of western land suitable for grazing. The western range area as a whole comprises nearly 40 percent of the total land area of the continental United States. About half of this range area is in private ownership; the remainder is in Federal grazing districts, national forests, Indian reservations, State lands, and other withdrawals and reservations.

Deteriorated ranges are widespread over much of this vast area. Millions of acres are eroding more or less severely, reducing soil productivity, impairing watershed services, and adding to the silt load of major western streams.

Watershed-protection problems on the national-forest ranges are thus repeated on many other western range lands. Generally at the higher elevations, the national forests include many of the most important watershed lands. But any comprehensive effort to conserve water supply and reduce floods must take into consideration the whole vast range country of the West.

WE CAN HAVE GOOD WATERSHED MANAGEMENT

Through research and experience, we have learned something about good watershed management. There is much more to be learned. But even with the simple knowledge that water unless checked runs downhill, and that vegetative growth helps to check it, we can do much to prevent flood damage and increase supplies of usable water.

Most of our watershed forests and ranges can be managed to provide good water-flow conditions along with their judicious use for timber production, livestock grazing, recreation, and other values. Over much of the larger portion of the area, adequate fire protection, range management adequate to maintain forage cover, and proper silvicultural practice to maintain good forest growth will generally serve to

protect the watersheds. On certain critical watershed areas, however, special treatment is needed; and on a considerable area tree planting or reseedling to grasses is needed to restore the vegetative cover.

What can we do to bring about the kind of land management that will safeguard our water supplies, regulate stream flow, and keep our soil in place?

Increase upstream flood-control work.—The Flood Control Act of 1936 for the first time gave specific congressional recognition to the role of watersheds in Federal flood-control policy. Under this act, the War Department remains the national agency for downstream engineering, including levees, dams, and other channel engineering works for flood control, while the Department of Agriculture is authorized to make surveys and undertake control measures for runoff and water-flow retardation and soil-erosion prevention on the watershed lands. The Forest Service and the Soil Conservation Service of the Department of Agriculture cooperate in this work.

When a flood-control survey is made under this act, the condition of all watershed lands in the river drainage is studied, the sources of flood runoff and sedimentation ascertained, the causes analyzed, and recommendations are made for corrective action. Corrective work emphasizes the restoration and proper management of watershed cover, including reforestation or revegetation, intensified fire control, and changes in land use. It may include where necessary such supplemental upstream engineering work as channel and stream-bank stabilization, contour trenching, road stabilization, and construction of small dams to check gullies. Congressional authorization and financing are necessary for each watershed project.

Flood-control work under the 1936 act was greatly curtailed during the war years. Work has been resumed on a number of projects, and the Congress has appropriated funds for additional surveys on several river drainages. But many more are needed, and there should be prompt follow-up action when the surveys are completed.

Billions have been spent on levees, dams, and other large-scale engineering works as downstream defenses against floods. But we cannot expect to provide the permanent safeguards which the national welfare requires unless we give adequate attention to watershed conditions on the lands upstream—where the floods come from.

Expand public watersheds.—Who owns the land often determines what happens to the watershed. The individual landowner naturally is interested in getting a living from his land, or a prompt return on his investment. But the use to which he puts that land in his own immediate interest may be damaging to watershed values. Often he cannot afford to do all the things necessary to protect the watershed or properly maintain its functions. Yet the value of his land to the public as a watershed may far exceed its value to him as an individual.

For key watersheds—where the public values in land and water are paramount, public ownership may therefore be the best means of safeguarding these watershed values. Akron, Asheville, York, and many other cities and towns have found it desirable to acquire the once privately owned watersheds that furnish their water supplies. Other cities, which derive their water supplies from streams whose sources are far away, may have to look to acquisition by the State and Federal Governments to protect their watershed interests.

Purchase and management by Federal, State, or community agencies is becoming increasingly desirable for critical flood-source areas, and for those upstream lands most important as water-supply sources where individual owners cannot afford to undertake the necessary measures for watershed protection. It is often the best guarantee that soil loss will be checked, that flood hazards will be minimized, and that useful water supplies will be available to provide opportunities for expansion of power, community water supply, and irrigation developments to meet our growing needs.

Intensify national-forest management.—On the important national-forest watershed lands, the Forest Service is making every effort to meet its responsibilities with the funds and facilities available. But its forces and facilities are spread thin over a large area. There is need for more intensive management on many national-forest timberlands and ranges; for tighter protection against fire; for more tree planting, range reseeding, and upstream engineering work on deteriorated watershed lands.

On the whole, it can be said that the national-forest watersheds are in better condition than most other wild-land watersheds of the country. But they should be developed and managed for the maximum in watershed service, under a multiple-use system which will at the same time yield full and continuing returns from their other resources.

Improve forest and range practices on private lands.—Good management must also be applied on watershed lands in private ownership. On forested watersheds, timber management and cutting practices should be promoted that maintain a continuing growth of trees and keep soil in place. The Forest Service has repeatedly urged aggressive action to this end: Public controls to prevent use of destructive methods in timber cutting; increased technical assistance and other cooperative aids for private forest-land owners to encourage wider adoption of good timber management practice; and intensification of control work against forest fires and destructive forest insects and disease. Such measures will contribute both to watershed protection and to increased timber supplies.

On depleted forest and range lands in private ownership, tree planting and reseeding programs should be stepped up. Such work will serve to improve watershed conditions and to restore wasted lands to productivity.

More research on watershed management problems.—Foresters have learned that it is possible to improve the water resource. By keeping the forest or range vegetation dense, floods can be reduced. By maintaining the soil in absorptive condition, ground-water supplies can be augmented. By removing trees and shrubs which are heavy water users or which intercept too much snow more good water can be made available for man's use.

But there is still a lot we don't know about how water behaves. We need to know more about the effects of various types and densities of vegetation on water runoff. We need to know more accurately the effects of various methods of timber cutting. We need to learn how timber and grass and other wild-land crops can best be utilized without adverse effects on watersheds. We may even find it possible to grow

and harvest timber, or graze livestock, in ways that will increase water yields over those arising from virgin areas.

The search for knowledge must go on in the field of watershed management, as in all other fields. Progress stops when we quit learning.

This discussion has to do primarily with wild-land watersheds—forest and range lands—which are the particular concern of the Forest Service. Most cultivated farm lands are also parts of watersheds, and the Soil Conservation Service of the Department of Agriculture is earnestly endeavoring to promote good water conservation and soil stabilization practices on farm lands. The efforts of the Forest Service and the Soil Conservation Service supplement each other, and the two agencies work in close cooperation.

Much of the wealth of our Nation has derived from our utilization of the soil, water, and forests which nature gave us. Fundamentally, our wealth is based upon the balance that existed between the water, land, and vegetative resources. That balance is being thrown out of kilter in many places. We shall do well to work for the restoration of that balance through wise and foresighted management of the land. We should work for a way of life that will not be under pressure to destroy the basis of its own existence.

THE NATION'S TIMBER SUPPLY

The reappraisal of the forest situation in the United States, completed last year, showed that saw timber is being taken from the forests one and a half times as fast as it is being replaced by growth. It showed that much of the drain on the forests is of high-quality material, whereas the growth is generally of poorer quality. In regions covered by the forest survey it showed that in little more than a decade the volume of standing saw timber had been reduced by 14 percent. The trend is definitely toward saw-timber scarcity.

The reappraisal indicated that only 8 percent of all timber cutting on private forest lands could be classed as good or better, from the standpoint of keeping the forests adequately productive. Twenty-eight percent was rated fair; 64 percent was poor to destructive. It is to these privately owned forest lands that we must look for the bulk of our timber supplies.

There have been some encouraging developments. Industrial owners of forest land continue to show interest in managing their lands for continuous production. Many are employing trained foresters. More "Tree Farms" are being sponsored by forest-industry organizations, the owners being pledged to a program of timber growing. Several national and regional associations of lumbermen and pulp and paper manufacturers are working actively to promote good forest practice. On the national forests, progress was made toward more intensive timber management. A cooperative agreement was made for joint long-term management of a large tract of public and private timberland in the State of Washington—the first unit to be established under the Cooperative Sustained Yield Units Act of 1944.

But there has been no significant change in our over-all forest situation. The downward trend of the forest resource has yet to be reversed.

An American Forest Congress in Washington, D. C., in October 1946 helped to focus attention on the Nation's forest problem. This meeting was called by the American Forestry Association as an open forum for public discussion of the forest situation and of a proposed national program for forestry. Representatives of forest industries, labor, Federal and State forestry agencies, and various civic and conservation organizations participated. The discussions showed wide areas of agreement as to the measures needed to stop forest depletion and build up timber growth.

Chief point of controversy was the question of public regulation of forest practices. There was general agreement that some form of public control was necessary to require forest owners to avoid destruction of growing stock and follow practices that will maintain continuous forest production on lands not to be devoted to other uses. But opinion was divided on how it should be done.

Out of the discussions the American Forestry Association formulated a "Program for American Forestry" which it hoped would win wide support. This program, if carried out, would be a big step toward checking depletion and building up the forest resource. It calls for effective protection of all forest and watershed lands from fire; intensified control of destructive forest insects and diseases; expansion of technical assistance to owners of small forest properties; increased forest planting; more research in timber growing and harvesting and in wood utilization; and regulation of timber cutting practices by the several States.

However, the Forest Service considers the program inadequate in some important respects. It fails to provide for the prompt and aggressive action needed to bring critical watershed areas into public ownership, or to speed up public purchase and development of forest lands obviously not suited or destined for successful permanent private development. The program relies wholly on action by the individual States to establish public controls to prevent destructive cutting. The Forest Service believes that basic Nation-wide standards are necessary, and that there must be some guarantee of Nation-wide application if some States fail to do the job. The problem of permanent timber supply is Nation-wide, and time is running short. It cannot be solved by piecemeal measures.

Prompt action is needed. We were unable to meet fully the demand for lumber and other forest products in wartime. If supply balances peacetime demand, it may be largely because prices and other economic factors are such that people cannot afford to use the lumber they otherwise would. In other words, we shall be meeting the active demand but not the real need.

Even so, current levels of domestic consumption are being maintained only by drawing heavily on the remaining stands of virgin timber in the West and by continuing to deplete saw-timber growing stock in the East. Decisive steps should be taken to build up forest productivity for future needs.

Newsprint Situation

Although per capita consumption of pulp and paper products in the United States is by far the highest of any country in the world,

there is every prospect that our domestic requirements will further increase. Pulp and paper supplies have been short of demand during and since the war, especially newsprint. Small papers, and some larger ones, are having great difficulty obtaining enough newsprint paper to meet their needs. Congressional committees have been investigating the newsprint situation.

Mills in the Northeast and the Pacific Northwest provide the bulk of the newsprint produced domestically. But the United States is dependent largely upon other countries, primarily Canada, for more than 80 percent of its newsprint. Canadian newsprint production could be expanded, but any immediate large expansion could probably be made only by cutting into Canada's timber capital.

Newsprint accounts for only a small part of the total output of pulp and paper products in the Northeast. And to meet current needs, the industry in this region is drawing on Canadian forests for about a third of its total pulpwood supply. The pulp and paper industry in the Lake States likewise is importing from Canada about one-fourth of the pulpwood it consumes. With the kinds of trees now used, the Northeast and Lake States could expand newsprint production only by transferring their output from other paper and paperboard products to newsprint. Actually the trend is in the opposite direction.

The South is producing large quantities of kraft paper from southern pine. Its 51 mills represent half of the total United States pulpmill capacity. Several new mills are under construction, and most existing mills have plant-expansion programs under way. Newsprint paper also can be made from southern pine. One mill has been turning out this product and another is planned. There is strong competition, however, for wood in this region, both within the pulp and paper industry and also between it and the producers of lumber, poles, ties, and other timber products. Pine timber growing stock is decreasing. Any large expansion of newsprint production from southern pine, therefore, under present utilization practices and continued high demand for timber, must be either at the expense of other products, or must result in further decreasing the productive growing stock. Increased pulpwood supplies might be obtained through utilization of hardwoods, but this would involve changes in wood-procurement methods, manufacturing processes, and machinery. Greater utilization of cull trees and logging and manufacturing waste could also extend the raw material supply of the pulp and paper industry, if problems such as those of cost and the wide distribution of the waste material could be met.

Southern forest land is capable, under good management, of producing much larger crops of wood. Undoubtedly, potential growing capacity of southern pine timberlands, if developed by good management, could eventually support a large-scale expansion of pulp and paper making in the South. To the extent that growth is built up, there could be a proportional increase in newsprint production without further timber depletion.

The Rocky Mountain region has large supplies of timber suitable for pulping, but because of costly logging, long distance from markets, and problems of power and water, there is little prospect of immediate establishment of a pulp and paper industry in that area.

In the Pacific Northwest, the paper industry is competing with the lumber and plywood industries for raw material. There are opportunities for more intensive utilization of vast quantities of wood now wasted in this region. If the trend toward closer utilization continues, and economic indications are that it may, some expansion in the pulp and paper industry on the west coast is possible. But, depending on economic and other factors, this might be chiefly in other paper products, rather than newsprint.

Pulp and Paper From Alaska

Southeast Alaska offers an opportunity for early development of a pulp and paper industry that could greatly increase our supply. It has two prime requisites for paper production—suitable kinds of timber, and good water-power resources. Water transportation can be used both for moving logs to mills and for shipping out paper from the mills.

Nearly all the commercial timberland of this Alaska "panhandle" region is within the Tongass National Forest. The Forest Service will follow a policy of managing this timberland primarily for the production of pulp timber on a sustained-yield basis.

Two years ago the Forest Service invited prospective operators to investigate the possibilities of establishing paper mills in Alaska. Tentative proposals were received from two groups in 1947.

The situation has been complicated by a large number of Indian claims asserting ownership to extensive tracts of land within the national forest. However, Congress enacted legislation in July 1947 which provided that purchasers of national-forest timber may operate under sale contracts free and clear of all Indian claims based on possessory rights. All fees collected by the Government for stumpage on the Tongass National Forest will be held in escrow pending the determination of such rights.

Following passage of this legislation, the Forest Service advertised for bids on two large timber tracts in the Tongass National Forest. Contract terms were designed both to safeguard the public interest and to provide adequate security to the operators' investments. Operators will be required to follow cutting practices that will insure continuous timber growth. At present it is not known whether the pulp and paper developments will be devoted primarily to newsprint or to other paper products.

Recent proposals to throw open the national forests of Alaska to homesteading may be a deterrent to early development of a paper industry in the Territory. Transfer of these tremendously valuable public resources into a large number of small ownerships would lead to unintegrated piecemeal exploitation. Undoubtedly many tracts would sooner or later come into the hands of speculators. It would result in disintegration of the national forests of Alaska. It could make possible a repetition of the same story of wasteful dissipation of forest resources that has occurred in so many places in the States. It would discourage the huge capital investments necessary to establishment of pulp mills, and work against the development of settled communities, industrial security, and permanent employment that should result from the orderly growth of a permanent pulp and paper industry in Alaska.

The Problem of Wood Waste

The reappraisal of the Nation's forest situation made by the Forest Service during 1945 and 1946 included a study of wood waste—the first attempt to size up the problem on a Nation-wide scale. A report on this phase of the reappraisal was issued in 1947.

The study showed that of all the wood cut or destroyed in logging in the United States only 43 percent winds up in useful products, other than fuel. Twenty-two percent is used as fuel, much of it inefficiently. Thirty-five percent is not used at all.

This waste includes tree tops, limbs, cull logs, and other material left to rot in the woods after logging; slabs, sawdust, and edgings at the sawmills; materials lost in pulping liquors; and other wastage in primary and secondary manufacturing of wood products. It all added up to an estimated total of 109 million tons in 1944.

Some of this waste is used by sawmills and wood-using plants as boiler fuel, but often a great deal more wood is burned than is needed for efficient heat. And much of the material used for fuel could be put to better purpose if efficient handling and processing techniques were developed.

Transportation costs, lack of plant facilities, and other economic factors make the problem difficult. Much of the waste wood is so scattered that it cannot at present be economically salvaged. But whatever wood we can save that is now wasted, or put to better use than it is now put to, will advance the Nation's welfare by providing more useful goods, additional industry, and employment. There are many possibilities. It is possible, for instance, to convert waste wood into industrial alcohol and high-protein stock and poultry feed. Sawmill trimmings and short pieces that cannot be sold as lumber could be made into small-dimension stock, or into many small articles that are now generally cut from standard-length lumber. Much logging and mill waste might be used for pulpwood, or converted into chemical products. Several forest industry concerns are making notable progress along these lines.

Both Government and industry are conducting research in wood-waste utilization. We have already obtained much more knowledge of how to reduce waste than it has as yet been possible to apply. But we need to develop still better ways—new techniques for harvesting wood and making products with less waste, and new ways of utilizing what is now wasted.

We need also to get such knowledge into use, through increased technical assistance to woodland owners and wood processors. Where it is necessary to establish the practicability of new waste-utilization processes, public aid in financing pioneering operations might be desirable. Credit on favorable terms, or in some cases subsidies to cover the financial risks of a new enterprise, would often hasten the commercial application of new technological findings.

One major need in attacking this waste problem is greater integration of the timber-products industries. One-product operations, still typical of the forest industries, tend to be wasteful. The pulp and paper industry could use more of the wood now wasted in lumber operations, and other chemical industries could use more of the wood substances now carried off in waste pulping liquors. Integration of a

variety of wood-using industries in a given locality would make possible more complete and advantageous use of the forest crop. Encouraging developments along these lines already can be found in the Pacific Northwest, the Lake States, the West Gulf region, and elsewhere.

Management of forests for sustained yield will be an incentive to such integration. Operators can develop their plants and plan to stay in business permanently when there is assurance of a continuing supply of raw material.

Waste reduction will not of itself solve the problem of balancing timber growth and drain at the desirable level. We still have to grow wood, even to waste some of it. But cutting down waste can make our timber supply go farther. It can give us more wood products without increasing the drain on the forests.

Forest Insects and Diseases

A reappraisal report on forest insects and diseases was issued in 1947. Diseases and insects are causing greater losses in standing timber than does fire. Much less progress has been made in controlling them.

In most parts of the country, man's activities have upset the natural balance among native organisms in the virgin wilderness. Complicating the situation still further is the accidental introduction of a number of highly destructive foreign pests.

During the decade 1934-43, the estimated timber loss from insects and diseases was 622 million cubic feet each year. Average annual drain from fire during the same period was 460 million cubic feet.

This estimated drain caused by insects and diseases represents only the more obvious losses, usually occurring as a result of epidemic outbreaks. The total effect would be vastly greater were it possible to measure the damage caused by the normal activity of a myriad of disease and insect pests ever present in the forests. White pine weevils, for example, damage the top shoots of millions of young white pines in the Northeast and Lake States, resulting in crooked and forked trees of lowered commercial value. The brown spot disease of young longleaf pines in the South slows the growth of young seedlings for perhaps 10 to 15 years. Trees weakened by root rot are more subject to windthrow. Wood borers, such as the locust borer and ambrosia beetles, lower the value of wood by their borings. Various bark beetles and borers, cankers, wilts, and rusts cause reduced or deformed growth.

Epidemic outbreaks can cause tremendous losses. Spruce budworm has killed balsam fir and spruce trees over large areas in Canada and budworm damage is becoming serious in New England. A larch sawfly epidemic caused the loss of practically all mature larch stands in the Lake States. Pine bark beetle infestations in the West have caused heavy losses and little salvage of infested trees has been possible. The white pine blister rust disease has invaded all regions where white pine occurs, and destroyed much young white pine. The chestnut blight in 40 years destroyed the American chestnut over its entire commercial range.

An effective attack on the insect and disease problem will require:

- (1) An enlarged program of research to discover and develop the best

methods of control; (2) a detection system, with surveys and observations by competent technicians, to locate potential danger centers and spot incipient outbreaks; and (3) a control organization equipped and ready for immediate action.

The Forest Pest Control Act (Public Law 104, 80th Cong.) enacted in 1947 recognizes the Federal concern and responsibility in the control of forest insects and diseases on a Nation-wide basis, and on lands in all classes of ownership. It paves the way for establishment of more adequate services and facilities for prompt detection and suppression, and authorizes Federal cooperation with the States and with private forest-land owners to combat outbreaks of forest pests and parasites.

Educational work with private forest-land owners and the general public, to spread knowledge of the principles of forest management and protection, also will help meet the pest problem. In the long run, good forest management, applied on a Nation-wide basis, will be the best defense against most insects and diseases. Healthy, vigorous trees in well-managed forests are better able to resist attack.

COOPERATION IN STATE AND PRIVATE FORESTRY

Forest-Management Assistance to Woodland Owners

The bulk of the woodlands from which the Nation's supply of forest products must come is privately owned. Of the 345 million acres of private commercial forest land, 75 percent is in small holdings, averaging less than 62 acres each. By and large, these small woodland tracts are the most accessible areas for growing trees. And trees must be kept growing on them if these lands are to continue supplying timber.

Small forest holdings include 139 million acres in farm woodlands, divided among 3.2 million farmers. Another 122 million acres is held by a million nonfarm owners—investors, small businessmen, owners of estates, and others. Many of these are absentee owners; with them the problem of encouraging good forestry practice is especially difficult.

Most timberlands owned by farmers and other small owners are in an understocked condition, with poor species and low-value trees predominating. Overcutting of the better-quality timber, lack of improvement cuttings, and poor management are reflected in yields and financial returns that are far below potential levels. With most of the small woodland owners timber is a side-line business, if any attention is given to it at all. Many do not realize the real value of their woodlands, and those who do often handle them with no thought of producing continuous crops of trees and steady cash incomes.

Under the Norris-Doxey Act of 1937, 153 cooperative farm woodland management projects are now operating in 39 States, with about 600 counties involved. Most of the projects are under State direction, the Federal Government sharing half the cost. The technically trained Norris-Doxey forester provides specific in-the-woods advice and assistance to the individual farm-woodland owner. Working with the owner or his representative the project forester does such work as making a simple management plan covering planting, thinning, pruning, and harvest cutting, and protection from fire, insects, and grazing.

If timber is ready for harvest he advises and assists the woodland owner in marking the trees to be cut, in estimating the volume, in proper cutting methods, and in marketing the products. When planting, thinning, pruning, or protection are needed, he shows the woodland owner what to do and when and how to do it.

During the fiscal year 1947 these project foresters assisted 13,531 owners to apply improved management practices on 1,576,888 acres of woodland. A total of 502 million board feet of saw timber was cut under their advice. Value of the saw timber and other products cut and for the most part sold by the woodland owners assisted amounted to almost \$8,000,000. This included the harvest and sale of 6,870 barrels of gum for naval stores and 136,289 gallons of maple sirup. About 5,000 small sawmill owners and other small forest-products operators were advised and assisted by the project foresters in marketing products from the small woodland areas. The year ended with 2,673 unfilled requests from small owners for in-the-woods assistance in their management problems.

Although progress has been gratifying considering the small number of Norris-Doxey foresters employed, only a small start has been made in attacking one of the toughest phases of the Nation's forest problem—the small woodlands, in which only 4 percent of present cutting meets the demands of good silviculture, and in which 71 percent of the cutting is poor or actually destructive. Also, 97 percent of the 45,000 active sawmills are run by small operators, many of whom need advice and assistance on up-to-date technical methods applicable to their operations.

On the large and medium-sized holdings that make up the remaining 25 percent of the privately owned woodlands, the owners of approximately 20 million acres have been given technical aid in the past 9 years by foresters working either out of the regional offices of the Forest Service or cooperating in State foresters' offices. Even though this work with the larger owners has always been on a limited scale, some significant results are apparent. About two-thirds of the larger owners assisted have adopted improved practices and are maintaining them. In addition, many large owners have employed technical foresters or engaged private consulting foresters and are now looking to the Forest Service for assistance in advancing the broad technical standards of forestry rather than for assistance in actual management of the woodland.

Forestry Extension Work Among Farmers

Education or extension work in farm forestry is authorized by the Clarke-McNary and Norris-Doxey Acts. This work is a part of the general extension program carried on through the land-grant colleges by the Extension Service of the Department of Agriculture in co-operation with the Forest Service. The work complements the direct technical assistance to forest owners reviewed above and the distribution of forest planting stock by State agencies.

Sixty-five State forestry extension specialists in 45 States and 2 Territories conduct a unified farm forestry program among farm people through county agents. The State specialists are responsible for the preparation of the necessary subject matter, visual aids, and information material; for conducting method and result demonstra-

tions; for work with rural youth, such as 4-H Club groups; and for introducing new and improved farm forestry practices. During the past year, extension foresters gave demonstrations and disseminated information on cruising, marking, and marketing farm timber; naval stores operation; production of maple sirup and Christmas trees; farm fire prevention; establishment of shelter belts and windbreaks; thinning and pruning of timber; preservative treatment of fence posts and other farm timber; and utilization of farm-grown timber. The extension foresters also encouraged the use of tree planting stock produced by the State foresters.

The use of newly developed mechanical equipment for growing and harvesting farm-woods crops is being demonstrated by many of the extension representatives. This includes tree-planting machines, chain and circular power saws, a machine for tapping maple trees, and various other labor-saving devices.

Cooperative Tree Distribution to Farmers

During the fiscal year 1947, the Forest Service cooperated with 41 States and 2 Territories in the production and distribution of forest tree planting stock as authorized by the Clarke-McNary and Norris-Doxey Acts. Forty-three and one-half million tree seedlings were distributed at cost, or less, for farm planting to restore woodlands or establish shelter belts. These trees were grown in State-owned or State-operated nurseries and were distributed by State agencies. The 41 States, together with Puerto Rico and Hawaii, budgeted \$1,207,569 of their own funds for the production and distribution of planting stock during the year. Of this amount, \$699,619 was devoted to growing and distributing trees to farmers. The Federal contribution amounted to \$118,291.

Interest in tree planting has increased to a marked degree since the war. All of the cooperating State agencies have reported that they were unable to meet the demand for planting stock in 1947. In some States 50 percent of the orders could not be filled. This shortage of nursery stock is an inevitable result of the war. Scarcity of labor for nursery work as well as for forest-planting operations made necessary a sharp curtailment of nursery production during the war years. The continued labor shortage and a scarcity of seed have retarded nursery expansion since the war ended. It requires from 2 to 4 years to produce forest-planting stock in the nurseries. Therefore, production is not expected to catch up with demand until about 1950, and then only if funds are available to finance nursery expansion.

There is widespread interest in tree planting to stop erosion. In the protection of watersheds and the retarding of wind and water erosion, tree planting is often necessary. Much important watershed land is in farm ownership.

There are some 44 million acres of farm lands in this country that should be planted to trees, either to reestablish productive woodlands or to protect watersheds, or both. The area planted since the cooperative tree-distribution program was started in 1925 is less than a million acres. To accomplish the total job within a reasonable time will require much more rapid progress than has occurred in the past 20 years.

Naval Stores Conservation Program

For the twelfth consecutive year a Naval Stores Conservation Program was effective in 1947. Administration of this program was delegated to the Forest Service by the Production and Marketing Administration. Approximately 3,000 turpentine farmers, representing about 85 percent of the total production, participated.

The production of gum naval stores is more and more becoming recognized as an integral part of good timber management throughout the naval-stores belt of the Southern States. During a period of from 7 to 20 or more years prior to final harvesting of the timber crop, longleaf and slash-pine stands will provide the timber owner with a yearly income from naval stores. This period of turpentine farming also affords employment for a large volume of labor.

The objective of the Naval Stores Conservation Program has been to develop better methods of turpentine farming in accordance with approved forestry standards. Requirements for participation include: (1) Adherence to a minimum diameter for working trees—which makes for economic operation, minimizes the damage to growing trees for future use for lumber and other forest products, and generally tends to develop better timber stands; (2) cooperation with local fire-protection units, and the use of other measures to protect timber stands from forest fires; (3) compliance with timber-cutting standards designed to promote continued production and to provide for restocking of timber upon which the naval stores, pulp and paper, lumber, and other wood-using industries of the region are dependent.

Congress made provision for continuing this program in fiscal year 1948 on a reduced scale.

Cooperative Fire Control on State and Private Forest Lands

Federal assistance in forest-fire prevention and control on State and privately owned forests under section 2 of the Clarke-McNary Act was extended to one additional State (Iowa) during 1947. This brings the number of cooperating States to a total of 43 plus Hawaii, and through them many thousands of private forest owners also cooperate in the program. Cooperating States increased the area under organized protection by 15½ million acres during the year. The fact remains, however, that 120,000,000 acres, or 27 percent of our State and privately owned forest land, is still without any form of organized protection from fire.

Congress recognized the need for strengthening and extending cooperative protection work by increasing the appropriation for Federal cooperation from \$7,300,000 in the fiscal year 1946 to \$8,300,000 for 1947. This, together with increased State appropriations, made it possible to bolster protection work in many areas and initiate it on some of the hitherto unprotected forest lands. Several States also have taken initial steps in additional unprotected areas into which organized protection will be extended in the fiscal year 1948.

Fires burned 2,252,795 acres of protected State and private forest land in the calendar year 1946 (latest year for which complete reports are available). The number of fires on protected lands increased from 48,176 in 1945 to 66,103 in 1946. But the area burned over in 1946

was 204,000 acres less than that burned in 1945. It was 871,000 acres less than the 5-year average for the years 1941 to 1945.

No complete fire records are available for the 120 million acres of unprotected non-Federal forest land. The best estimates of State officers most familiar with what has happened in these areas indicate that 18,117,460 acres of unprotected forest land was burned by 96,500 fires in 1946. This was 15 percent of the total unprotected areas. On protected lands, area burned was only seven-tenths of 1 percent of the area protected.

Under present law Federal participation in cooperative fire-protection work is limited to \$9,000,000 per year, and this amount has been appropriated for the fiscal year 1948. A thorough review and analysis of the area of State and privately owned forest lands needing protection has been made and the total cost of the job recomputed for each State. Because of increased costs of personnel, equipment, and supplies and a more thorough understanding, based on past experience, of what is required to do an effective fire-prevention and fire-suppression job, estimated Nation-wide costs have increased from \$18,000,000 (1939 estimate) to approximately \$32,000,000. On a 50-50 sharing basis, this means that the Federal share of the over-all job will amount to \$16,000,000 annually.

The revised area figure of 439 million acres needing protection includes approximately 16 million acres of highly important non-timbered watershed land, most of which had not been in previous estimates.

The highest priority job of the State and Federal Governments, as partners in this cooperative fire-prevention and suppression work, is to extend protection to the 120 million unprotected acres as rapidly as possible. Protection from fire is a fundamental step toward helping each of these acres contribute its maximum in wood products, recreation, watershed protection, and other benefits to the community, State, and Nation.

Fire-Prevention Campaign

The wartime campaign against carelessness in the woods is being continued as a Cooperative Forest Fire Prevention Campaign, with splendid cooperation from the advertising industry. The Advertising Council, Inc., deemed the forest-fire-prevention problem of such importance that it offered to continue to provide free campaign planning, designing, and distribution services for a cooperative program with State and Federal forest services. Some \$3,000,000 worth of advertising space and radio time was donated by business and industries in 1947. This campaign is designed to develop a Nation-wide consciousness of the need for preventing forest fires and of the personal responsibility of each citizen to avoid acts of carelessness that cause fires in the woods. Individual States supplement the national campaign with prevention material designed to attack special State or local situations.

Community Forests

The rise during recent years in the number of community forests is a spontaneous expression of the general public interest in forestry. People want public forests right in the home community because of

the various ways in which they contribute to better living. Recognizing that managed community forests can make important contributions to community welfare, the Forest Service is encouraging the establishment of this type of public forests. There are now 2,489 established community forests with an aggregate area of 3,209,856 acres. The number increased during the fiscal year 1947 by 110. However, there are several million more acres of forest land in county and municipal ownership to which little or no management or development work has as yet been applied.

More than 300 community forests with a combined area of over a half million acres are situated on municipal watersheds for the protection of domestic water supplies. An almost equal area of watershed forest land is owned by private water companies supplying water for municipal use.

THE NATIONAL FORESTS

Timber Management

A rapid increase in the rate of timber cutting on the national forests in the fiscal year 1947 resulted in a total cut of timber under sales and exchanges of 3.8 billion board feet—half a billion feet above the highest previous record. Receipts from timber sales increased to \$15,400,000 from \$10,600,000 in the fiscal year 1946.

During the year close cooperation with the Federal Housing Expediter was maintained to develop a maximum contribution from the national forests toward providing more lumber for veterans' housing. A timber-access road program was undertaken involving 316 projects, with 1,443 miles of construction and 636 miles of betterment. Total estimated cost of this program was approximately \$18,900,000, of which \$12,900,000 was supplied through the Housing Expediter. The program was about 75 percent complete on June 30, 1947.

The additional timber output that these roads will make possible will build up largely during the next 2 years, since construction of most projects was not completed until the latter part of the fiscal year 1947. However, 300,000,000 board feet of national-forest timber was hauled over newly constructed access roads in that year. Approximately 1,000,000,000 feet was expected to be hauled over these roads during the fiscal year 1948, but the total may fall short of this mark because of a reduction in funds available this year for cruising, preparation, and administration of timber sales.

Ceilings on stumpage prices prevailed until the termination of price controls in November 1946. During this control period, when tie bids at ceiling rates were received from prospective purchasers, sales were awarded in the interest of maximum production of materials needed for the housing program. After termination of price controls awards were made to high bidders and a strong upsurge in stumpage prices occurred. This increase in prices is not yet fully reflected in the average value of timber cut, since most of the timber currently being cut is under contracts executed prior to the termination of price controls.

The increase in demand for stumpage has made it possible to sell species and types of material that have seldom heretofore been merchantable. It has been possible to make improvement cuttings through

commercial sales as well as cutting of decadent elements in mature stands in advance of regular harvest cuts. White fir in California and "mixed species" in the inland empire are examples of materials now utilized that previously had extremely limited marketability. If present trends continue, cutting capacities and resulting support for local communities from the national forests, can be increased because of fuller utilization.

Increasing demand for poles and fence posts also provides opportunities for more intensive timber management. A sizable pole industry in eastern Montana has now been established, based primarily on lodgepole pine timber from the national forests.

Efforts of the Forest Service to develop pulp production in Alaska have already been mentioned. Preliminary negotiations have been under way for a major timber sale in western Montana which would make feasible the establishment of a pulp mill in that area. Some national-forest timber is being shipped from eastern Montana and Colorado to Lake States pulp and paper mills. In Colorado the shipments are from a large area of insect-killed Engelmann spruce on the White River National Forest. In the South the amount of pulpwood available for sale from national forests is increasing rapidly as the result of fire protection, stand improvement, and reforestation during the last 10 or 15 years. These expanded pulpwood thinning possibilities on the southern national forests may help provide a basis for additional pulp and paper-manufacturing facilities in the South.

During the year two major insect control projects were carried out. In the vicinity of Moscow, Idaho, airplane spraying of DDT was conducted on 413,500 acres in cooperation with the Bureau of Entomology and Plant Quarantine to control the most violent outbreak of tussock moth ever experienced. The project cost approximately \$650,000; the timber at stake was estimated to have a potential lumber value of \$60,000,000. Private landowners and the State of Idaho contributed nearly half the cost. It was by far the largest forest insect epidemic control operation yet undertaken. It involved 2,120 individual airplane flights to distribute 391,000 gallons of insecticide. No living tussock moth caterpillars could be found on treated areas after the spraying.

In southern Idaho a widespread epidemic of bark beetles in lodgepole pine threatens to wipe out all of the mature timber of this type over a vast area including Yellowstone Park. More than 40,000 infested trees were felled and treated during the spring working season of 1947, which it is hoped will break the back of this infestation. However, follow-up work will be needed for several years to bring this infestation under full control.

The Shelton Cooperative Sustained-Yield Unit

The first unit under the Cooperative Sustained Yield Units Act of March 29, 1944, was established in December 1946 through agreement between the Forest Service and the Simpson Logging Co. of Shelton, Wash. The agreement provides for the sustained-yield management of 270,000 acres of forest land for 100 years.

Located in the southern base of the Olympic Peninsula, this unit includes 111,000 acres of national-forest land and 159,000 acres of private land. It is calculated that the timber harvested from the

entire acreage will supply local industries with about 90 million board feet of raw material every year, continuously. These industries, assured of a regular supply of timber by the cooperative agreement, will support the towns of Shelton and McCleary, with populations of 4,700 and 1,400 respectively. The cooperating company now employs about 1,400 workers. The sustained-yield agreement assures these workers permanent jobs.

Most of the national-forest land involved supports old-growth Douglas-fir, western hemlock, and associated species. This area of public timberland could have been managed on sustained yield without consideration of the 159,000 acres of private land included in the cooperative venture. But the annual cut would then have been only about half of what can be cut under coordinated management of the two properties. Logging-company lands include mostly second growth not yet large enough for sawlogs. If the company lands alone were operated under sustained yield, the allowable annual cut would be very small for the next 40 to 50 years until these second-growth stands became merchantable. By combining the management of the large area of old-growth national-forest timber and the more extensive second-growth stands of the company, it will be possible to maintain essentially the present rate of cut. Under this agreement, good forestry practice on the private land is assured. The old-growth timber on both the private and national forest land will be allotted for cutting in an orderly fashion. Growth accruing in the young stands will provide the desired annual harvests of sawlogs after cutting of the old-growth stands is completed. New growth meanwhile will be coming along on the earlier-worked areas, so that operations may be continued indefinitely.

The Forest Service recognizes a need for similar action to support other communities by a sustained flow of forest products. A number of proposals are under active consideration.

Range Management

In the calendar year 1946, the Forest Service issued 18,686 pay permits for the grazing of 1,203,200 cattle, and 3,501 permits for the grazing of 3,712,980 sheep. With the calves and lambs, for which no fee is charged, and the additional stock grazed under free permits to local settlers, nearly 10,000,000 animals grazed national-forest ranges.

Fees paid into the United States Treasury for grazing use in the fiscal year 1946 amounted to \$2,293,773. Grazing fees on the national forests are adjusted annually in accordance with the market price of beef and lambs for the preceding year. Under this procedure, cattle fees per head per month increased from an average of 27 cents in 1946 to 31 cents in 1947. Sheep fees increased from 6.25 cents to 7.5 cents.

For the fiscal year 1947, Congress appropriated \$553,596 for reseeding of depleted range lands in the national forests. Approximately the same amount was appropriated for the fiscal year 1948. To date, close to 200,000 acres of national-forest range have been artificially reseeded.

Some of the basic problems of range management on the national forests are discussed earlier in this report. (See p. 9.)

Watershed Management and Flood Control

Progress is being made in the initial development of watershed management plans for national-forest drainage basins. This work, begun after the war, will provide the basic information needed for guiding land uses and management of forest resources more accurately, in order to make available the full potential usefulness of national-forest water resources. To make watershed management plans most useful, certain inventories relating to national-forest water resources will be needed to supply better quantitative data as a basis for management. As funds become available, the Forest Service plans to make further studies on the national forests of actual and potential water yields, soil conditions, present and prospective water requirements, and other factors.

Research indicates the possibility of increasing the amount of water available for stream flow in zones of heavy snowfall, through different methods of timber cutting. Consideration is now being given to the selection of several watershed units in Colorado, where the effect of cutting methods on water yield can be given a field-scale test in the course of regular timber-sale operations.

Watershed control work under the 1944 Flood Control Act, to ameliorate runoff and consequent flood damages, has been centered in the Los Angeles, Yazoo (Mississippi), and Potomac River watersheds. The Los Angeles project has emphasized the installation of fire-control facilities to protect the highly inflammable mountain brush cover, and the design and initiation of improvements to effect better control of certain units of steep mountain channels. In the Yazoo Basin, erosion control on barren roadsides is well under way on the Holly Springs National Forest. Land-capability classification, as a basis for control measures, is being worked out jointly with the Soil Conservation Service. In the Potomac River watershed a cooperative timberland-improvement program with private owners has been initiated through the State of Virginia.

Recreation

Public use of national forests for recreation climbed sharply in 1946 from the wartime levels and reached a new high of 18,240,000 visits. Early reports indicated that the number of visitors in 1947 would be substantially greater.

The improved national-forest recreation areas, including 4,537 camp and picnic areas and 236 winter sports areas, represent a tremendous public recreation asset. The camp and picnic areas cover 52,773 acres and can accommodate at one time 43,000 family-sized groups or some 280,000 individuals.

Sixty-five organization camps maintained by the Forest Service are made available to local public-spirited groups, largely for the benefit of children who could not otherwise afford a forest vacation. These camps had 242,000 days of use in 1946.

The 236 winter-sports areas embrace 82,025 acres and can accommodate 167,000 people for skiing. Most of these areas have shelters and first-aid facilities. Ski lifts and ski tows in most cases are provided under permit by private operators. Winter-sports areas were measurably improved by the construction of 12 lifts by private

capital under special-use permit during the past year. Each represents an investment of \$40,000 to \$60,000.

In addition to these specially developed recreation areas, many people enjoyed the national-forest trails, fishing streams, hunting areas, and wilderness country. Wilderness areas were visited by 144,000 who spent 406,000 days in them. Six million visits, adding up to 10,000,000 man-days, were tallied on other national-forest areas for such purposes as hunting, fishing, riding, hiking, nature study and photography, and other hobbies.

National-forest land is used extensively also for camps, resorts, and summer homes constructed and operated under permit by private individuals or concerns. Facilities of this type are permitted to the extent needed to serve the public. Under such special-use permits, 335 organization camps provided 2,460,000 man-days use in 1946; 505 resorts provided 4,319,000 days of use; and 13,442 summer homes were used by owners and guests for 3,947,000 man-days.

Rehabilitation and restoration of public recreation areas has been the big job for 1946 and 1947, since maintenance work was largely suspended during the war years. Heavily used areas are receiving first consideration, and repair of water systems, sanitary improvements, and safety and fire-prevention facilities are the priority jobs.

A study is under way to determine the proper relation between resort income and the fee due the United States for use of the land. A sliding-scale percentage of the gross income is under consideration and is being discussed with resort owners.

A 5-year-long controversy has revolved around proposals to open a portion of the San Geronio Primitive Area in the San Bernardino National Forest of southern California for development as a winter-sports area. Following a public hearing held by the Forest Service early in 1947, it was decided that watershed values would be best protected and the long-term public interest best served by maintaining the area as a permanent wilderness. The area, however, will afford opportunities in wintertime for back-country or wilderness skiing.

Special Uses

Applications for use of national-forest lands by individuals and organizations for other purposes in addition to recreation are increasing in number. It has become increasingly necessary to scrutinize applications to determine possible conflict with national-forest purposes.

Special-use permits cover a wide variety of uses—for churches, schools, cemeteries, stores, service stations, fur farms, pipe lines, power lines, oil, gas, and mineral developments, and many others. Paid permits yielded a return to the United States Treasury of \$658,124 during the fiscal year. Many free permits also were in effect under Regulation U-11, which authorizes free permits for certain public, semipublic, or noncommercial uses.

Mineral leasing functions on acquired lands administered by the Secretary of Agriculture have been transferred to the Secretary of the Interior, as directed by the President's reorganization plan No. 3 of 1946. Existing mineral leases and permits within the purview of the plan were turned over to the Bureau of Land Management for administration. A procedure for the issuance of new leases and per-

mits was agreed upon. Applications for new oil and gas leases on national-forest lands increased greatly and some 100 have been reported on by the Forest Service. Revenues from mineral uses of lands acquired for forestry purposes continue to be deposited as national-forest receipts.

Wildlife Management

The national forests are the home of a large share of the country's wildlife. The density of big game is more than twice as great as on lands in any other type of ownership (more than one-third of the country's big-game animals are on the national forests). There is also a wide variety of small game and birds. There are 90,000 miles of fishing streams and over 1½ million acres of mountain lakes. Furbearers are found throughout the national forests, the most important perhaps being the beaver, a species nearly exterminated a quarter of a century ago, but now common on many forests.

As had been anticipated, the past year brought a great increase in numbers of hunters and fishermen in the national forests. Hunters using the national forests totaled 1,345,000 as compared with 1,017,000 in the preceding year. Fishermen increased from 1,922,000 to 2,730,000. This represented a 39-percent growth in over-all sportsman use.

This expansion is indicative of a national trend which may continue upward for several years. The growing demand will increase the pressure upon the land to produce more game and more fish. This will call for even closer correlation of wildlife management with the grazing, timber, recreation, and watershed management activities on the national forests, and for practices that will maintain and improve the wildlife habitat along with these other values.

In regions that are low in hunting pressure and where the habitat has been favorable, the Forest Service is sometimes confronted with excess game populations. On some areas deer and elk herds have increased beyond the ability of the range to support them. Serious damage to soil and vegetation, and starvation and disease loss in the herds has resulted. Correction of these unsatisfactory conditions is worked out in cooperation with State game authorities and involves developing better methods of utilization and big-game management that will bring the numbers into balance with their natural food supply.

During the war years, the wildlife work was greatly curtailed. If the national forests are to make their maximum contribution to the wildlife resource of the Nation, it is apparent that steps must be taken that will bring the work to a level at least comparable to that maintained before the war. Specially trained technicians are needed on the areas where the most pressing problems exist, to coordinate wildlife management with other uses of the land, and to facilitate carrying out active programs of cooperation with the various State game and fish departments. A heavy backlog of needed stream and lake survey work, game inventories, and studies of wildlife habitat conditions has accumulated.

Work along these lines must be largely postponed, however, since no funds were appropriated by Congress for national-forest wildlife management and protection in the fiscal year 1948.

Progress in Controlling Forest Fires

Much of the fire fighting done by the Forest Service is in the defense of watersheds. In semiarid regions, fires are particularly destructive to watershed cover. This is true in southern California, in much of the Rocky Mountain and intermountain regions, and in the Southwest. In mountainous areas in such regions, a burn of only a few hundred acres often upsets the critical balance between soil cover and normal runoff. Experience of recent years has provided several examples of single fires that have resulted in millions of dollars of damage to property in valleys below.

This relationship between watershed protection and the permanence of community development in tributary areas makes the success of forest fire protection a grave responsibility. As more investment and development proceeds in these tributary areas, the size and importance of the fire-protection job increases as well. Many adjustments in plans must be made in the endeavor to meet local needs.

The present protection job for which the Forest Service is directly responsible involves a total of 196 million acres of national-forest and intermingled land. During the calendar year 1946, a total of 11,886 forest fires were controlled. Of this number, 6,779 were man-caused. This marks a sharp increase over 1945, for which 4,878 man-caused fires were recorded. Despite this increase in number of fires, the area burned was held to 247,174 acres, a reduction of over 23 percent from the area burned over in 1945.

The forest fire control organizations were operating under many postwar difficulties and below adequate strength. In 1946 it became necessary to do all fire fighting with Forest Service employees and such sources of labor as could be recruited locally. Military manpower and facilities, which were drawn on heavily to meet emergencies in 1945, were no longer available.

In early spring, high winds and dry conditions resulted in bad fires on national-forest lands in lower Michigan. In a few hours an area of 23,000 acres was burned over. In the southwest, the worst drought conditions in years developed in Arizona, Nevada, and New Mexico in early June. In the Southern States there was a 48 percent increase in man-caused fires over 1945. In northern Idaho and western Montana, 1,315 lightning-caused fires occurred in July and August. This number had been exceeded only four times in the last 40 years. On a single national forest, 207 fires had to be fought during one 15-day period. In Washington and Oregon, 800 fires were fought during a 12-day period in August.

Such emergency situations place an extreme overload on any fire organization. To meet such situations successfully, high morale, careful training, and long hours of strenuous work are required. That these requirements were met is evidenced by the record.

Use of aircraft contributed much to the success of forest fire control in most of the western regions. A highly trained force of 230 parachute fire fighters were recruited and organized early in the season. These "smoke-jumpers" were placed in crews that operated from strategic points in Montana, Idaho, Washington, Oregon, and California. They again demonstrated their value and further established the place of aerial operations in inaccessible forest territory. One

large block of wild country along the Continental Divide in Montana was protected primarily from the air, as in 1945, with good results. These operations were carried forward in 1947 with some further extension. A group of parachute fire fighters was tried out on the Gila National Forest in New Mexico in the summer of 1947. Results obtained will determine further plans in this area.

Work in the development of new equipment and new fire-fighting methods has made considerable progress. Many new wartime advances show promise of being valuable in the solution of forest fire control problems.

Two experimental projects now under way have attracted much interest both at home and abroad. In a cooperative project between the Forest Service and the Army Air Forces started in 1946, an R-5 Sikorsky helicopter was given intensive tests on two national forests of southern California. The purpose was to test the potential usefulness of this type of aircraft for Forest Service work, particularly fire fighting, since the helicopter can be used to transport fire fighters both to and from fires in inaccessible locations while conventional airplanes can deliver men by parachute only. Much was learned, and desirable modifications of the helicopter to adapt it to forestry work were indicated.

The second project is also being undertaken jointly with the Army Air Forces. Its purpose is to test the feasibility of holding threatening forest fires in check by use of military bombing techniques with water or fire-extinguishing chemicals. Actual bombing of fires was started in June 1947, and positive results to guide future plans and operations will be available by the end of the year. Both the Forest Service and the Army Air Forces expect to learn much that will be of value beyond the immediate goal of better peacetime defense against forest fire losses.

Fire detection and control require rapid communication from remote and relatively inaccessible areas to points of manpower and material supply, to aircraft serving these back-country areas, and between suppression crews on the ground. The Forest Service pioneered in the development of portable two-way radio equipment which has since come into wide use by other agencies, and was a forerunner of the Army "walkie-talkie" which played such an important part in the conduct of the war.

The radio laboratory maintained by the Forest Service at Portland, Oreg., is working constantly to improve and simplify radio communication and adapt commercial developments and products to the specific needs of forestry work. Frequency modulation (FM) has recently been adopted for all equipments operating in the very high-frequency range. Among new items of equipment developed by the laboratory, which were needed by field units but were not commercially available, are a single-unit mobile transmitter and receiver, and a 7-pound "handy-talkie." The handy-talkie included a highly sensitive receiver and two independent transmitting channels or frequencies. The unit has been simplified so that only three switches are needed in its operation; it has no dials or external tuning adjustments.

A long list of other new equipment and materials, such as wetting agents to improve the extinguishing action of water, improved hose nozzles, four-wheel-drive transportation equipment to get men and

fire equipment to fires over difficult terrain, and more efficient debris- and dirt-moving equipment to build fire line, gives much promise of improving the efficiency of fire-fighting forces.

The particular problems ahead that must be solved arise from three factors. The first is the mounting number of man-caused fires resulting from increased travel and recreational use of the national forests since the war. Another is the abnormal amount of logging slash and other hazardous fuels created by increased timber cutting. During the war period, clean-up of these special hazards had to be deferred. Allowances for accomplishing such clean-up were based on prewar cost. It is inevitable that higher fire hazards must be dealt with in the years immediately ahead. The third factor is the change in economic and social conditions that has made former methods of employing fire fighters obsolete. Unemployed labor is no longer freely available for fire fighting and industrial labor must be drawn on in emergencies. The high cost of such labor and lack of woods experience among available workers make it essential that as much of the work as possible be accomplished by mechanical means. Increased mechanization of the job has been seriously slowed down by shortages and obsolescence of equipment. This handicap must be overcome, new effort must be devoted to preventing forest fires, and increased efficiency through new developments must be pushed, if the increasing postwar problem is to be met successfully.

Improvements and Facilities

The Forest Service is continually working to keep up and improve the equipment and facilities needed not only for fire protection but for efficient management and development of the national-forest resources. A big backlog of maintenance and replacement work has accumulated. During the war, construction of fire-lookout stations, telephone lines, etc., was confined almost solely to those essential to protection of strategic facilities and operations for war purposes.

The backlog of needed facilities includes ranger dwellings, ranger offices, barns, equipment and supply sheds, bunkhouses, guard cabins, sanitary systems, range fences, water developments, and many others. Housing of field personnel has become an acute problem since the war, because of lack of replacement of worn-out structures, lack of available private housing, and an expanded workload. Many rangers and other field personnel and their families are having to reside in tourist camps, temporarily converted office buildings, and other places not designed for regular living quarters, and in some cases are having to commute excessive distances to their work.

Construction and maintenance of access roads, essential for increased timber production, was the major activity of the Forest Service's Engineering Division during the past year. Very little other forest-road development and highway construction was accomplished. During the war many highways deteriorated rapidly because of heavier loads and postponement of maintenance. The volume of traffic is now greater than before the war. Many national-forest highways are important links in the State and transcontinental highway systems, and their improvement and extension should go forward in line with the general pattern of betterment of the country's highways.

Topographic mapping work progressed during the year on the Prescott National Forest in Arizona, the Colville in Washington, and the Plumas in California. It is planned to start work on the Trinity National Forest in California in 1948. About 1,880 square miles of planimetric surveys were completed, and 39,165 square miles of aerial photography were placed under contract in the Western and North Central regions. For only about 15 percent of the national-forest area, however, are maps adequate in scale, accuracy, and detail available.

National-Forest Properties

At the end of the fiscal year, 153 national forests, 43 purchase units, 14 experimental forests or ranges, and 10 land-utilization or similar projects were being administered by the Forest Service. The gross area within these units was 228,810,442 acres, of which 179,314,756 acres were publicly owned and under Forest Service administration. This net area was an increase of 393,280 acres, compared with 1946.

During the year one new national forest, the Six Rivers, was established by combining parts of the Trinity, Klamath, and Siskiyou National Forests in California. The purpose was to give better on-the-ground administration to an area that is assuming increasing economic importance and to give greater service to local people. Several shifts of land between other national forests also were undertaken in the interest of more economical management.

For the first time since 1942 a substantial sum was appropriated by Congress for the purchase of land for national forests. A net of \$2,590,000 was made available for purchase of lands under the Weeks law and an additional \$138,000 was appropriated for purchases under several of the so-called forest-receipts acts. These latter acts authorize the appropriation of receipts from certain national forests, or parts of national forests, for the purpose of acquiring land within such forests. They relate chiefly to areas in which purchases cannot be made under the Weeks law because of the limitations of that law, but within which additional public ownership is highly desirable, and has been approved by local counties, to aid in watershed protection and control of floods and erosion.

During the fiscal year 1947 a total of 1,014 tracts involving 371,671 acres were approved for purchase under the Weeks law. With the exception of those in the Arrowrock purchase unit in Idaho, the Weeks-law purchases were in national-forest purchase units east of the Great Plains. Many of these units are at the headwaters of important rivers, where consolidation of public ownership will facilitate the protection and management of these areas for the regulation of stream flow. Nineteen purchases, involving 8,800 acres of land, were approved under the receipts-acts appropriation for additions to national forests in Utah, Nevada, and southern California.

In addition to purchases of land, 114 applications to exchange privately owned land for national-forest land or timber were received and acted upon. During the year title was accepted to 459,929 acres of land which had been offered to the Government in exchange. For the land so accepted a total of 149,240 acres of national-forest land and 598 million board feet of national-forest timber were or will be granted.

While progress is being made in consolidating the national forests, it must be emphasized that a large and urgent task yet remains in building up our national-forest system to the point where it will fully and effectively achieve the objectives of public service. Within purchase areas approved by the National Forest Reservation Commission, about 24 million acres of land chiefly suited for timber production and watersheds still need to be purchased to complete the development of these units for public forestry purposes. There are also an additional 10 million acres of intermingled private lands within the boundaries of other national forests, principally west of the Great Plains, which should be consolidated with the surrounding publicly owned lands to assure their future protection and progressive management for timber production, stream-flow protection, erosion control, and corollary benefits.

A hodge-podge of diversified ownerships within the boundaries of national forests not only is expensive from an administrative standpoint but also acts to minimize the effectiveness of conservation measures instituted on the public land. Without public control, the intermingled privately owned lands are subject to denudation, unwise cultivation, or other detrimental practices. It is therefore greatly in the public interest that the national forests and purchase units be consolidated and built up as expeditiously as possible.

Effective planning and administration of land-purchase activities would be enhanced by greater uniformity and continuity of appropriations for that purpose. Wide variation in the year-to-year appropriations prevents effective planning of the work, makes difficult the maintenance of an efficient organization, and may lead to loss of effort and funds in appraising, surveying, and acquiring land.

There is much to indicate that local communities and residents are becoming increasingly aware of the need for expansion of the national forests to include areas of public interest that have been or are now being abused or improperly managed. Several requests were received during the year from communities, local organizations, and groups of residents for the establishment of additional national-forest purchase units in their vicinity to improve watershed conditions or to restore and maintain timber production. Bills were introduced in Congress during the year at the request of local citizens to enlarge the boundaries of five national forests in California, Washington, Idaho, and Utah by a total of about 372,000 acres.

RESEARCH

Forest Management

Demands for the know-how of forest management are increasing in all the timber-producing regions of the country. The regional forest experiment stations therefore continue to increase the load of applied forest management studies in addition to the basic research program. In the fiscal year 1947, Congress authorized establishment of 19 new research centers, bringing the total to 53, of which 36 are wholly or partially concerned with forest management research. About 30 additional centers are needed to complete the series for the whole country so that the problems peculiar to all the important forest types and economic regions can be given consideration.

As the business of exploiting forests for the highest immediate profit gives way to the business of management for highest continuous yield, the need becomes imperative for realistic information on: (1) Harvesting timber crops with due regard to maintaining productivity at a high level and reproducing the forests by natural seeding; (2) improving and tending forest stands so that they will grow better products faster; (3) protecting forests from fire, insects, and diseases; (4) measuring the crop and the costs and returns from the forestry enterprise; and (5) planting trees on denuded or poorly stocked forest lands where nature will not restore them.

A major problem in the Pacific Northwest is the transition from a timber economy based on virgin Douglas fir to one based on second growth. One suggested method for smoothing the way was partial cutting of the virgin timber to prolong the cut of this material. The Pacific Northwest Forest Experiment Station has compiled results from a series of long-time observations on 10 typical partial cuttings. The results are discouraging. They show an annual average net loss of over 1,400 board feet per acre during 5 years since cutting. The loss consists of the volume of trees that died or were blown down; it does not count the additional loss from decay in the reserved stand that follows logging injury to trees. Other studies indicate that in partial cutting one-third of the reserved trees may be damaged during the logging and that such trees may lose sound wood volume through decay at a rate of 1 percent a year. Obviously, partial logging in virgin Douglas-fir as practiced to date has failed to accomplish the objective of converting static forests to growing forests. A better method seems to be clear-cutting in strips or patches with provision for natural seeding-in from uncut stands bordering the clear-cut areas.

In second-growth timber at the Crossett Experiment Forest in Arkansas the selection system—cutting the larger and more mature trees and leaving the others—is used to maintain a thrifty stand and to harvest high-quality products that bring maximum returns. A question to be answered was whether the average size of trees and logs selectively cut at successive short intervals would drop, reducing future returns. After 9 years, data show that fears of declining sizes were unfounded. Trees removed in the first cutting averaged 20 inches in diameter, breast high. Growth was so rapid following cutting that this average diameter has been maintained in successive cuts.

The spruce-fir type in the Rocky Mountains appears best adapted to some form of partial cutting. However, tests by the Rocky Mountain station have shown that this method results in excessive windthrow of trees, amounting to a loss of from 100 to 150 board feet per acre per year in the partially cut stands. A group-selection system—cutting heavily in small patches and leaving patches of untouched, reasonably wind-firm growing stock between—has reduced windthrow losses to about 50 board feet per acre per year. Here, as in many other forest types where the selection system is applicable, lighter and more frequent cuts seem to be best. And with increasing demands for timber products this kind of cutting is becoming economically possible over wider areas.

Evidence continued to accumulate that attention to immature stands results in marked improvement in future growth and yield and often provides immediate income. A 50-year-old stand of loblolly and short-

leaf pine in Louisiana that has been thinned every 5 years for the last 30 years has produced 64.2 cords per acre during that time, while the unthinned check plot produced only 48.2 cords per acre. The southern station has found that highest growth rates in southern pines have generally been obtained where thinning is heavy.

The Northeastern Forest Experiment Station has been experimenting with the response of second-growth northern hardwood forests to various degrees of cordwood cuttings. In one series of tests it tried cutting to a 5-, an 8-, and an 11-inch minimum diameter limit. The rates of annual growth per acre during the first 5 years following the cutting were 38, 62, and 74 cubic feet, respectively. At this rate the time required to replace the volume removed would be 55, 27, and 15 years, respectively. These figures show one advantage of the high diameter limit, namely, the faster rate of growth after cutting. Another advantage is that cutting operations are more efficient where a high diameter limit is used because 1.9 times more solid wood can be cut per man-day from trees 11 inches and larger than from trees 5 to 8 inches in diameter. Furthermore, the cost of the wood to the distillation or pulpwood companies is less for stacks containing larger trees, the amount of solid wood in piles made up of 11-inch and larger trees being 18 percent greater than in piles made up of 5- to 8-inch trees.

Measurement of the volume and rate of growth of forest crops is important in the business aspects of forestry because such measurements represent a significant portion of the costs of planning and operating forest management enterprises. Research at the Pacific Northwest station recently resulted in the publication of a manual for the calculation of growth in ponderosa-pine forests. At the Rocky Mountain station an efficient scheme was worked out for estimating the volume of timber cut in national-forest sales, by measuring a sample of the trees. The cost is less than the cost of the old method—measuring all of the logs cut—and the total volume is determined just as accurately. At the California and southwestern stations volume tables were tested and revised; the northeastern station analyzed and tabulated diameter-growth rates of anthracite-region species for different forest sites and tree-vigor classes. Preliminary attempts to streamline growth-prediction methods in the complex, all-aged hardwood forests of the Appalachian region show promise that existing expensive methods can be greatly cheapened and simplified.

Reforestation of the banks of raw earth left behind by strip mining on more than 100,000 acres in the Central States presents an unusual planting problem. A survey of plantations already made on spoil banks in Indiana and Illinois leads to the conclusion that spoil banks can be afforested; that past failures have been more often due to unskillful planting than to conditions in the spoil banks themselves; that spoil banks in the Central States should eventually be covered with hardwoods, but on many of them pines or black locust must first be used to improve the soil so that the hardwoods will grow; and that leveling of banks is not necessary—it may actually reduce productivity. The survey also shows that further research is needed to find out about survival following controlled, skillful planting; about nutrient make-up of spoil-bank soil strata; about rates of rock disintegration; about recovery of soil organisms in raw spoils; about the natural succession of plants on spoil banks; and about the economics of pasture versus forest use of these lands.

Studies of the costs of good forest management and the returns from it are being emphasized at the research centers recently set up by the regional stations. Results from such studies on the older, well-established Dukes, Olustee, Blacks Mountain and Crossett experimental forests are already well known. Plans for others at the new research centers have been completed and first cuttings are now under way. Significant among the development at these new centers has been the formulation of research advisory councils recruited from technicians representing the industries, landowners, and conservation groups within the research center province. These councils confer with center technicians on programs and review accomplishments. Although the time required by advance planning of the programs has received some criticism, careful, well-rounded consideration of the needs for technical information in each research center province is vital before funds are committed to a long-time research program. Formulation of advisory councils, completion of problem analyses, and holding of program conferences with the councils have now been completed at most of the new centers.

Forest Economics

The Nation-wide survey of forest resources, which was largely held in abeyance during World War II, has been reactivated on a substantial scale. Before the war about half the forest lands in the United States, or some 300 million acres located in the South, Lake States, Pacific Northwest, and northern Rocky Mountains had been surveyed and reported on through 231 publications and forest type maps for 16 States. Under the resumed current program of work new surveys were initiated on about 38 million acres of forest land in Arkansas, California, Maine, Missouri, Montana, New Hampshire, New York, Pennsylvania, and West Virginia. In addition, data were brought up to date for about 21 million acres in areas initially surveyed 10 to 15 years ago.

Special attention is being given in these new forest surveys to developing improved techniques in timber-inventory procedures, and to making fuller use of aerial photographs by applying modern photo-interpretative skills. Information is being collected by States and counties and reports will be issued as rapidly as inventory data are compiled.

One of the new ways in which forest survey data are being used was demonstrated in a study of forest land assessment for taxation purposes. This study, conducted in cooperation with the State of Maine, shows that current information on the condition of timber stands can be obtained from aerial surveys and that this information can be used as the basis for more equitable tax assessments. Such improvements in taxing practices help make forestry more attractive financially.

For use in carrying out reconversion policies with regard to forest products, a program for collecting current data on lumber production and stocks was continued at the request of the Civilian Production Administration and the Office of the Housing Expediter.

At the request of other governmental agencies and congressional committees, a number of regional, national, and international studies in the economics of forestry and forest products were prepared during the year. Examples of such studies included an analysis of forest resources and employment opportunities in forestry in the South, the

future of paper products that are competitive with lint cotton, the effects of proposed rate increases on railway revenue and forest utilization, pulpwood supplies of the United States, and timber supplies in relation to increased production of newsprint. In connection with the reciprocal trade agreements, analyses were made of foreign trade policies and problems with respect to forest products. The Forest Service also supplied the Food and Agricultural Organization of the United Nations with several reports on United States forest resources and forest-products production, consumption, and trade.

In the field of forest finance, assistance was given to a committee appointed by the Farm Credit Administration to prepare a comprehensive report on forest credit. This report analyzed the needs for and the problems of supplying forest credit and suggested a plan of organization for a federally sponsored system of forest credit.

Financial aspects of forest management have been the subject of a number of experimental studies in different parts of the country. Studies of a 40-acre tract of pine-hardwood second-growth timber in the Crossett Experimental Forest in southern Arkansas indicate that attractive annual financial returns can be obtained by managing timber as a farm crop. Following 9 years of cutting for lumber, pulpwood, and posts, the stand on this experimental tract is of better quality than when cutting started. Yearly financial returns have averaged \$4.18 per acre, stumpage value, or \$14.82 per acre when timber was cut and delivered at market. These returns rival those from cotton on similar land and indicate that forest crops may offer a means of diversifying southern agriculture.

Development of a long-term policy and program for the growing of white pine on national forests under the handicap of blister-rust damage is the aim of a study being conducted in the Northern Rocky Mountain area. Special attention is being directed toward the costs of growing different quantities of western white pine; the influence of site quality, ownership, and management practices upon the costs of blister-rust control; the regional and national values represented by white pine; and the establishment of a basis for blister-rust control priorities from the standpoint of sustained-yield forest management.

Forest Products

Research in forest-products utilization, most of which is conducted at the Forest Products Laboratory at Madison, Wis., continued to be directed toward obtaining a more efficient and more diversified utilization of the forest crop—specifically to get fuller utilization of low-grade material and wood waste, to make natural and improved wood give better service, to increase the use of little-used or unpopular species, and to widen the field of chemical conversion.

One of a number of methods the laboratory is using to increase the supply of seasoned wood is instruction courses in kiln-drying. During the year 11 courses were conducted, 2 at the laboratory and 9 at industrial centers, with a total enrollment of 294 persons. Seven of the courses were sponsored by industry, one by a university, and three by the Forest Service.

A manual has been completed on the subject of laminating structural timber products by gluing, based on experience gained over

the wartime years and since the war on the use of glues for building up large laminated beams from relatively thin boards. It covers the properties of glues suitable for laminating, the techniques of laminating, and recommendations for inspecting and testing laminated products.

In connection with the work being done on small-sawmill improvement a survey was made to observe and analyze small sawmills in Washington, Oregon, North Carolina, and Virginia. It was found that 32 percent of the mills were unnecessarily wasting material and that 90 percent were using equipment and labor inefficiently. Methods of detecting causes of poor quality of manufactured products and of eliminating these causes were outlined on the job, as well as efficient mill lay-out and operation.

Surveys were made in a number of forest regions of the country to determine the progress being made by loggers, equipment concerns, and others in developing new equipment and methods of harvesting timber, particularly small-size and low-grade timber. Some 20 loose-leaf notes were issued for the information of field agencies and timber operators, on new and special equipment. The surveys are to be continued and detailed studies of particular types of equipment will be made, including comparative output data and operating costs. Special attention is to be given to portable chippers, chip bailers, and portable barkers.

Although the laboratory has done extensive work on the strength and design of open crates for relatively small and light articles, no scientific information was available on large open crates designed to carry heavy loads. During the year testing and development work was done which made it possible to provide designs for loads up to 30,000 pounds net. A distinctly new type of construction involving the use of prefabricated panels in which diagonal braces are placed on both faces of the frame members was devised. It makes possible the use of much thinner lumber, and the crates can be made with 30 to 40 percent less lumber than the conventional fully sheathed crates.

The laboratory demonstrated that corrugating boards can be successfully made from woodworking wastes, such as those from box plants and furniture and veneer mills.

Certain fiber-manufacturing processes result in large wastes of hemicellulose. In connection with studies directed at the utilization of this material, hemicellulose byproducts received from commercial agencies were fermented to acetic and butyric acids by thermophilic bacteria. Yields of fermentation products ranged from 25 to 40 percent of the cellulosic material.

It was demonstrated experimentally that sawdust can be used for making boards of both the insulating and hardwood types in which highly hydrated or gelatinized wood pulp is used as the binder. For example, boards have been made consisting of 85 percent sawdust and 15 percent hydrated pulp. By adding rosin or asphalt size to increase water resistance, sample boards have been produced with excellent resistance to high humidities, steaming, or freezing. Although it has been shown that such products from sawdust are technically possible, the limits of their economic practicability have not been worked out and much remains to be done on this phase of the problem.

An illustrated manual on the use of wood for prefabricated housing was prepared for the National Housing Agency. Information included was based upon laboratory research and upon results of a Nation-wide survey of prefabricated-house manufacturers. Subjects covered include basic information on wood, plywood, laminated wood, modified woods, fiberboards, plastics, and sandwich materials; strength of materials; seasoning and storage; machining of wood and other wood-base materials; gluing; joints and fastenings; house design; fabrication procedures; and repair techniques.

During the past few years, interest in the use of radiant heating has increased rapidly and certain difficulties have arisen when wood floors have been laid over radiant-heating pipes. The principal difficulties so far encountered are buckling and shrinking of the wood floors, although some cupping also occurs. These difficulties are more prevalent in wood floors laid over radiant-heating pipes embedded in concrete floor slabs than where the pipes are supported by wood joists. Pending the completion of contemplated experimental work, specific recommendations for avoiding these difficulties cannot be made. But certain steps to assure use of dry flooring can be suggested as possibly reducing the likelihood of unsatisfactory results.

Range Research

As earlier sections of this report have indicated, restoration of the herbaceous plant cover and better management of the forage resource are urgent problems on the country's vast area of range lands. Solution of these and related problems is an essential step in obtaining proper watershed protection and efficient livestock production.

Range forage contributes importantly to the country's meat production. Roughly three-fifths of the cattle and calves, three-fourths of the sheep and lambs, and four-fifths of the shorn wool come from the Nation's principal range area, the 17 Western and Plains States and the 9 States of the South and Southeast. To fulfill the continued demand for meat will require the most careful use of our native forage and soil resources. The scientific methods of utilization required must have a sound and adequate research foundation. Research in grazing management must provide a fundamental understanding of the growth requirements of forage plants, their response to grazing, and the frequency and extent to which they can be harvested and still increase on deteriorated ranges, maintain their vigor and productivity, and provide necessary protection to the soil.

That better management will improve and maintain the ranges and provide greater watershed protection and a high level of livestock production at less cost has been illustrated by numerous research findings throughout the range country.

At the Santa Rita Experimental Range in southern Arizona, records of beef production have been compared in two adjoining range pastures stocked at different intensities since 1922. At the start one appeared to be more productive and was stocked approximately one-third heavier than the other. The more conservatively stocked pasture has maintained essentially the same production of beef over the years. In the heavier-stocked pasture it was necessary to make greater adjust-

ment, and in the last 6 years this range was stocked with only about one-third of the number of cattle that grazed it in the first period. During that last period it produced only 60 percent as much beef as in the first 6 years. The income from heavier stocking was slightly greater in the early years but less in recent years. This study clearly indicates the advantages of conservative stocking in sustained profitable cattle production.

Further evidence of the advantages of conservative stocking as compared with heavy grazing in restoring ranges following drought is clearly shown in the results of cooperative studies of sheep grazing at the United States Range Livestock Experiment Station in eastern Montana. Northern Plains ranges, when conservatively grazed, recovered rather rapidly during the 6-year period following the severe drought of 1936. Such desirable forage plants as blue grama, bluestem wheatgrass, needle-and-thread, and threadleaf sedge came back. During the same period heavily stocked ranges failed to recover, and remnants of blue grama and other palatable grass species were largely replaced by low-value annuals. It has required several years without grazing for the ranges depleted by heavy grazing to be restored to reasonable productivity.

More efficient utilization of timbered portions of western summer ranges can aid in providing adequate forage and greater stability for western livestock production. Many western summer ranges consist of intermingled meadows, sagebrush, and ponderosa pine types. Cattle naturally concentrate on the untimbered areas. This results in too close grazing and in damage to the forage and soil, and leaves timbered areas only lightly grazed. At the Burgess Spring Experimental Range in northeastern California, satisfactory utilization was made of the forage on all parts of the range by conservative stocking of the entire range and the construction of control fences. When cattle were kept on the timbered areas throughout the entire summer season the forage was readily eaten and they gained 205 pounds on the average as compared with 186 pounds when they were kept for the entire season on adjacent meadow range. In Oregon, rotational grazing of mixed forested and untimbered range types, concentrated on smaller portions for short periods, resulted in more efficient utilization of the timbered areas and encouraged recovery of untimbered range areas.

Fertilizing of range lands has generally not been considered profitable. In the annual forage plant type on the San Joaquin Experimental Range in the foothills of California, however, ranges fertilized in February 1944 and 1945 have shown considerable increase in forage, particularly of legumes. Cattle showed preference for the fertilized areas. The application of gypsum—the most successful of the fertilizers tried—more than paid for itself in increased grazing capacity.

In southwestern Louisiana where several million acres of longleaf pine land were so heavily cut years ago that it has failed to restock, there is considerable opportunity for an expanded forest planting program. Forest Service studies indicate that proper cattle grazing in longleaf pine plantations can return 75 cents or more per acre annually during the first 10 years when there is no other return from the land. Such grazing also reduces the fire hazard without damage

to the pine seedlings. After about 10 years of timber growth, forage growth declines rapidly. However, after the fifteenth year annual timber returns are greater than grazing values and can amount to \$3 or more per acre, and will continue to increase as the pine plantation develops. Thinning and proper cutting of the trees permits some grazing to continue. For the small landowner an annual income during the time that forests are being restored is important. Progressive planting and grazing thus can provide the key for rehabilitating forest lands and reconstructing the local economy on a sound continuing basis.

Grazing trials in the northern plains of Montana have demonstrated the high value and productive capacity of range land reseeded to crested wheatgrass, a species widely adapted for reseeding western ranges. During a 56-day period in the spring of 1947, 2-year-old Hereford steers grazing crested wheatgrass gained an average of 254 pounds each—slightly more than $4\frac{1}{2}$ pounds per day. These gains represent beef production of 79 pounds per acre for the period. This is several times the per acre production of most ranges in this region.

A 45-acre area in the mountain brush type of central Utah was controlled-burned in 1944, and seed of several adapted species was broadcast and disked in. In the second growing season more than a ton per acre of air-dried forage was produced, 20 times the amount of forage available before seeding. This excellent stand of smooth brome, crested wheatgrass, and other forage species is furnishing abundant forage in spring and fall for both cattle and sheep, controlling surface runoff, and protecting the soil against erosion.

Cooperative reseeding studies on piney-woods ranges in southern Georgia are showing some promising leads. On several forest-range soil types, a number of palatable grasses and legumes, introduced or developed by the Bureau of Plant Industry, Soils, and Agricultural Engineering and tested for use in cultivated pastures, are being tried to determine their adaptability to withstand forest shade, needle fall, and other factors in the forest not prevalent in cultivated pastures. These forest range reseeding studies are not designed to convert forest lands to improved pastures, but rather to determine what species can be established economically that will lengthen the nutritious forage season or give greater grazing capacity to the piney-woods land.

Research in Water-Resource Management

Watershed management research by the Forest Service is directly oriented towards solving problems discussed earlier in this report. The investigations are currently throwing more light on how watersheds function in producing useful water, and how the character of the soil and cover and their treatment affect these functions. The investigations have already driven home the fact that water is a major product of the land and that the degree of usefulness—or destructiveness—of this product is determined in large measure by the manner in which the land is protected and utilized.

It has not yet been possible to develop the watershed management research program on a scale commensurate with the needs. Of the 11 regional forest and range experiment stations within the continental United States, only 6 stations are thus far carrying on research in watershed management, and the individual work units are still not

adequately manned. Since watershed characteristics vary with climatic conditions, cover types, and soil and geologic formations, many important gaps still exist in our knowledge of specific regions. Nevertheless, considerable progress has been made at those stations where investigations are under way.

In the great interior basin of the West, summer rains are often of high intensity and were believed to be an important source of irrigation water supply. Studies by the Intermountain Forest and Range Experiment Station reveal that about 60 percent of the total flow from small sharp drainages in central Utah is currently lost because of unfavorable watershed conditions. On overgrazed or otherwise abused areas, flash runoff from intensive rains carries sediments rendering the flood peaks unfit for use. Yet when they are restored to a good cover under proper soil treatment, such areas can absorb a rain with the enormous intensity of 12 inches an hour without any damaging runoff. Much of the water absorbed into the surface soil mantle reappears later as desirable flow when most needed.

In Colorado, the Rocky Mountain Forest and Range Experiment Station has found that the deleterious effect of removing forest humus and litter is of long duration. The litter and humus were removed from the surface of the ground under a dense ponderosa pine stand, but were left undisturbed in a similar adjacent stand. After removal of this organic matter, new material was allowed to accumulate. After 5 years, the forest floor appeared the same under both stands. Nevertheless, with the same rainfall, the originally disturbed area still produced one-third more surface runoff and lost approximately two and one-half times more soil than the undisturbed area.

Observations and experiences at several research centers show that prevailing logging practices do far more damage to the water resource than was generally believed. In recognition of this fact, logging specifications are being developed for different forest types as a means of reducing soil and water losses from this cause. At the Coweeta Watershed Experimental Forest in North Carolina, a drainage area has been selected to test nondamaging logging methods.

This year the research staff at Coweeta has conducted a series of training seminars for national forest administrative personnel and for Federal and State technicians engaged in cooperative forestry activities. The results have already become evident in a stronger appreciation of the soil and water aspects of forest management. The staff is also being consulted on logging and related matters by the waterworks officials of several watershed-owning municipalities.

TROPICAL FORESTRY

Our only tropical national forest, the Caribbean in Puerto Rico, has a mean annual rainfall of 190 inches, with a recorded maximum of 253 inches in a single year. The first objective of the Forest Service in its administration and management of the lands within the Caribbean National Forest therefore must be watershed protection.

Experience gained by the Forest Service in handling the Caribbean Forest since 1917, backed up by forest research in the more recent years, has shown how the natural or wild forests in Puerto Rico can be managed to produce maximum yields of wood, in all forms from short sticks for making charcoal to sawlogs from trees 100 feet tall, and yet

not violate the principles of good watershed management on steep lands. Experience and research have shown, too, how necessary it is to establish and maintain forest growth on sparsely timbered and barren slopes throughout Puerto Rico and on parcels once cultivated but abandoned because the occupants could not raise enough to support their families.

Selectively cutting the natural forests, improving their composition and rate of growth, and promptly planting all lands needing it as they come into public ownership through purchase will provide, now and for the future, wood products sorely needed domestically and industrially in Puerto Rico. These methods also assure almost ideal protection of the watershed lands within the Caribbean which now supply water for three hydroelectric plants, two water reservoirs for irrigating the dry farm lands on the south coast, and domestic water supplies for scores of towns and settlements. That this program of forest management is working out successfully is evidenced by the fact that cash returns from the sale of timber products in the last 3 years equaled appropriations provided for the operation of the forest; yet at no time has the stand been opened up sufficiently to increase soil erosion or accelerate surface flow to an injurious degree. Only 150 acres of land without a protective cover remains to be planted within the present limits of the Caribbean Forest.

Timber is not the only resource of the Caribbean Forest which is managed on a sustained-yield basis. The national forest is a favored location with local people for such development as new water storage or supply projects, organization field camps, or recreational uses. Scattered throughout the forest are small parcels of land where soils are fertile and deep and the slopes are such that cultivation of food crops is practicable. Workers on the forest are given opportunities to occupy these areas, and thus are able to raise a part of their food crops and also obtain small cash incomes from harvesting forest products or from other work nearby. They live at a somewhat better standard than the bulk of the low-income people elsewhere in Puerto Rico.

On two areas of outstanding scenic value within the Caribbean Forest, improvements have been completely rehabilitated after non-attention during the war years. These areas were visited by 58,700 persons in 1946. To insure further enjoyment of these areas by the public, timber cutting, subsistence farming, and livestock pasturing are prohibited in their immediate vicinity. Food plants, and dead trees to provide nesting places, are left for the flocks of the beautiful Puerto Rican parrot (a parakeet) found in these areas.

The 11 insular forests, belonging to the people of Puerto Rico and aggregating 44,115 cuerdas (about 44,000 acres), are managed for the same objectives as the 31,499 acres in the Caribbean National Forest. Coordination of Insular and Federal forestry activities is assured by the fact that the Director of the Caribbean Forest serves also as the Chief of the Insular Forests.

A valuable contribution to information on tropical forestry was the publication during the year by the Forest Service's Tropical Forestry Unit of a 700-page scientific paper on forest ecology of all of the Caribbean Islands. The study was prepared by Dr. Henry Stehle, Chief Forester in the French Colonies in the West Indies.

FOREST SERVICE PERSONNEL

By the end of the fiscal year 1,150 members of the Forest Service who had served with the armed forces during the war had been restored to duty. Of these veterans 750 received promotions on or subsequent to their return from military service.

Official termination of the Emergency Rubber Project on December 31 also resulted in the return to regular positions of many who had been assigned to that project. The War Mapping Project, which the Forest Service carried on at the request of the Army and Navy and which was of great assistance to the military during the war, was also closed out during the year.

A dearth of new technical recruits, resulting from the war years, was in large part made up during the year as the result of civil-service examinations, the rating of papers by a department board of expert examiners (a new procedure), and appointments from the resulting registers. There were 307 new appointments in the junior professional (P-1) grade.

A number of Forest Service employees were made available as civilian technical foresters to assist our military governments in occupational activities: Two to Japan; six to Korea; one to Germany. One employee was transferred to the Food and Agriculture Organization of the United Nations.

A senior forester was detailed to the Republic of Panama for 30 days at its request to study the timber situation and make recommendations regarding major needs from a forest-resources standpoint.

A Pan-American In-Service Training Grant for a year of forestry training in the United States was awarded at midyear to a Brazilian; and at the year's end similar awards were made to one representative each from Guatemala, Costa Rica, Bolivia, and Argentina.

Sixty-three members of the Forest Service retired during the year. They averaged $62\frac{1}{2}$ years of age and $32\frac{1}{3}$ years of Government service.

Much work of the Forest Service is of a hazardous nature. To reduce the number of accidents, revised safety goals were established and the all-Service safety program was materially intensified during the year.

Forest Service work brings other hazards and difficulties as well. The recent move in the direction of reduced public expenditures has brought uncertainty to many workers. Some of our employees have been subjected to unusually severe and often unfair criticism. Nevertheless, the morale of members of the Forest Service is high, their spirit of public service is strong. Many have refused attractive offers from outside the Service because they believed in the work. Many have voluntarily stuck with the job long beyond the prescribed hours of work, with no thought of compensation for overtime. Many have risked their lives, and some have given their lives, in the service of their fellow citizens.

I believe the Forest Service can justly be proud of its personnel.

RECEIPTS AND EXPENDITURES

Receipts from the national forests during the fiscal year 1947 totaled \$18,372,799. Of this amount \$15,420,902 was received from the sale of timber; \$2,293,773 from the use of forage; and \$658,124 from special land uses, water power, etc. Distribution of receipts was as follows:

Returned to States in which national forests are located, as required by law, \$4,595,941; amount appropriated for expenditure by the Forest Service for (a) roads and trails on national forest lands, \$1,818,690; and (b) acquisition of national forest lands, \$136,686; balance returned to the United States Treasury, \$11,821,482.

Expenditures for the national forests aggregated \$46,462,951, of which \$13,050,985 was from appropriations for forest roads and trails, and \$2,637,760 for acquisition of land. The remainder, \$30,774,206, was for protection, development, and management.

Other Forest Service expenditures included those in connection with cooperation with States and private agencies in fire control, planting, and forest practice, \$8,921,087; contributions from outside sources for fire control, slash disposal, improvement work, etc., \$3,386,837; research, \$5,181,961; flood control, \$459,788; general administrative expense, \$680,296; Emergency Rubber Project, \$264,613; services for Insular government, Puerto Rico, \$93; and expenditures from proceeds of sale of parts and equipment, \$1,062,076.

Services for other Government agencies involved expenditures of \$7,128,809, including \$5,913,082 for Office of the Housing Expediter; \$333,315 for the Civilian Production Administration; \$127,063 for the Army; \$199,477 for the Navy; \$107,806 for the Public Roads Administration; \$101,786 for the Bureau of the Census; and \$346,280 for other agencies.

Total net expenditures were \$73,548,511. In addition, expenditures for which appropriations were reimbursed amounted to \$5,686,344. The gross expenditures by the Forest Service for the fiscal year 1947, therefore, were \$79,234,855. These expenditures were accounted for by objective and functional classifications under 114 separate appropriation titles.

The Forest Service was also responsible for the naval stores conservation program, involving payment of \$438,750 from funds of the Production and Marketing Administration.

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REPORT
of the
Chief of the Forest Service
1948

Our National Forests



UNITED STATES DEPARTMENT OF AGRICULTURE

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., October 1, 1948.

HON. CHARLES F. BRANNAN,
Secretary of Agriculture.

DEAR MR. SECRETARY: Half a century has elapsed since administration of our national forests began. It seems appropriate at this time, therefore, to review some of the accomplishments in the development of our national-forest system and to outline major objectives for the years ahead.

Our national-forest system is one of the largest, and in many ways it is the finest, public forest system in the world. It has developed steadily through the years, with encouraging support from the public, from Members of the Congress, and from the administration, regardless of what political party was in power. It has been and will continue to be the very foundation on which scientific forestry—forest conservation—in America is based. The national forests are performing useful and important services for the people of the United States; they are an important element in the national economy. With continuing support, they are capable of making even greater contributions to public welfare.

Sincerely,

Lyle F. Watts

LYLE F. WATTS,
Chief, Forest Service.

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OUR NATIONAL FORESTS

Although this report reviews accomplishments of the past year in all major fields of Forest Service activity, special emphasis is given this year to the national forests. Now that the national-forest system has passed its first half-century mark, an accounting of Forest Service stewardship seems in order, and a discussion of policies and programs for the years ahead.

Administration of the national forests is only one phase of Forest Service responsibility. In the interest of national security and welfare, sound management and wise use of forest resources must be promoted and encouraged not only on the public forest lands but on all other forest lands, and the Forest Service is carrying on a number of cooperative programs to this end. It is also conducting a program of research to provide knowledge essential to progress in forestry. Work and accomplishments of the past year in these fields are reviewed, and their relationship to and integration with national-forest administration are discussed in this report.

NATIONAL FORESTS IN 1948

About a half century ago, our Nation launched a new enterprise in public forestry. It began the administration of a system of national forests that has become a keystone of American conservation and an increasingly important part of the whole national economy. It is today perhaps the best public forest system of any country in the world.

Establishment of the national-forest system marked the first great step forward in the forest-conservation movement in the United States. Most conservation effort previously, and much of it since, found expression only in words—in reports and recommendations, warnings, and exhortations. Much of it has been merely wishful thinking. But the national forests are conservation in practice on the ground. They are going concerns. They still represent the largest tangible accomplishment in forest conservation in this country.

Our national-forest system is a tremendously important public asset which the Forest Service is endeavoring to manage in the best interests of its owners, the people of the United States. The national forests are making many contributions to local and national welfare. They have potentialities for far greater service.

DEVELOPMENT OF THE NATIONAL-FOREST SYSTEM

In 1891, by act of Congress approved March 3, the President was given power to establish forest reserves within the public domain.

On March 30 of that year, President Benjamin Harrison proclaimed the first reserve (now the Shoshone National Forest in Wyoming). Before his term expired, he set aside forest reservations totaling 13,000,000 acres. Presidents Cleveland, McKinley, and Theodore Roosevelt proclaimed many million acres of additional reserves in the Western States.

Congress, however, had provided no plan of operation for the reserves. They were simply closed areas, their resources locked up. Before that, anyone who wanted timber from the public lands had just gone in and taken it. Many public ranges had been seriously injured by unrestricted grazing. Large areas of public-domain timber were being grabbed by speculators through loose handling of the homestead laws or through outright fraud. Publicly owned resources were being rapidly dissipated.

Locking up the newly established reserves at least put a stop to some of that. But closing the forests was far from popular in the West. Their resources were needed by the growing western communities. Something more than mere preservation of resources was called for; the need was for wise, regulated use.

Then Congress passed the act of June 4, 1897, outlining a broad policy for management of the reserves which made it possible to open them up for managed use. This act, with later amendments, is the one under which the national forests are still being administered.

Until 1905, the General Land Office of the Department of the Interior had charge of the reserves. What forestry know-how then existed in the Government was in the Division of Forestry in the Department of Agriculture. Consequently, the General Land Office sought technical aid from the Division of Forestry—which in 1901 became the Bureau of Forestry. Later the Interior Department recommended transfer of the reserves to the Department of Agriculture.

The transfer was made by act of Congress approved February 1, 1905. The Bureau of Forestry became the Forest Service. The name "forest reserves" was changed to "national forests" in 1907. Under the vigorous leadership of Gifford Pinchot, the first Chief of the Forest Service, development of an effective administration for the national forests went ahead rapidly. Regulations for sale of timber under supervised cutting were put into effect. Livestock grazing was placed under permit. Fire protection was tightened.

Since little public domain remained east of the Great Plains, nearly all the early forest reservations had been made in the Western States. In 1911, Congress enacted the Weeks law, authorizing Federal purchase of forest lands for watershed-protection purposes. The Clarke-McNary law of 1924 broadened the authorization for this purchase program to include lands chiefly valuable for timber production. Under these laws more than 18,000,000 acres of forest land have been acquired for national forests to date, mostly in the eastern half of the United States. Other laws provided for acquisition of land for national forests through exchange or donation. Through purchases, land exchanges, donations, and additions by act of Congress, development of the national-forest system is still going forward.

Today we have 152 national forests located in 36 of the 48 States and in 2 Territories. There are also a number of designated purchase units within which not enough land has yet been acquired for them to

be set up as national forests. Within the boundaries of existing national forests and purchase units are some 229,000,000 acres; the net area of Government-owned lands is about 180,000,000 acres.

These national forests include areas representative of all the country's major forest types, from the great Douglas-fir stands of the Pacific Northwest to the "piney woods" and hardwood bottoms of the deep South; from the pine and spruce of New England to the chaparral of southern California. There are national forests also in Alaska and in Puerto Rico. The national forests contain, in the West, large areas of open forest and wildland range suitable for livestock grazing. They include a substantial portion of the relatively little virgin or old-growth timber still standing. They also include large areas where extensive rehabilitation work is necessary to restore forest growth that had been depleted by fire or destructive cutting, or both.

Greatest Good of the Greatest Number

The national forests are dedicated to the proposition that conservation is wise use. The policy under which these public forests were to be administered was stated in Secretary of Agriculture James Wilson's letter of February 1, 1905, to the Chief Forester:

In the administration of the forest reserves it must be clearly borne in mind that all land is to be devoted to its most productive use for the permanent good of the whole people and not for the temporary benefit of individuals or companies. All the resources of forest reserves are for use, and this use must be brought about in a thoroughly prompt and businesslike manner, under such restrictions only as will insure the permanence of these resources * * *. The continued prosperity of the agricultural, lumbering, mining, and livestock interests is directly dependent upon a permanent and accessible supply of water, wood, and forage, as well as upon the present and future use of these resources under businesslike regulations, enforced with promptness, effectiveness, and common sense. In the management of each reserve, local questions will be decided upon local grounds; the dominant industry will be considered first, but with as little restriction of minor industries as may be possible; sudden changes in industrial conditions will be avoided by gradual adjustment after due notice; and where conflicting interests must be reconciled, the question will always be decided from the standpoint of the greatest good of the greatest number in the long run.

These have been the guiding principles of national-forest administration ever since, and they are today.

In line with the primary objective of "the greatest good of the greatest number in the long run" the Forest Service applies two basic principles in the management of national-forest resources. One of these is the principle of "sustained yield." Sustained-yield management of timber means that the forest is managed for maximum continuous production of timber of desirable kinds. The techniques of sustained-yield management vary greatly with different forest types, but the objective is always the same—continuous renewal of timber crops to replace those harvested. The sustained-yield principle applies not only to timber, but to forage grazed by livestock, to wildlife, and to other renewable resources.

The other basic principle is called "multiple use." On a given unit of forest land, some areas may be especially suited for growing timber, some for grazing, some for big-game range. Much of the land may be important watershed. There may be some choice recreation spots; there may be mineral deposits or water-power sites that could be developed; there may be outstanding scenic values that should be safe-

guarded. Under the control of someone interested primarily in just one of those uses, the whole area might be set aside for that one use to the exclusion of all others—perhaps for timber production or for use as a hunting ground. Multiple-use management, however, looks to the coordinated development and use of all the resources and values of the land. Conflicts between various uses are adjusted under over-all management plans. A combination of several uses is usually possible on the same area. Through multiple-use management the Forest Service seeks the highest total of public services and benefits from the national forests.

National-Forest Resources

Timber

National-forest timber is for sale. Unless the amount involved is small, timber is sold through public advertisement, to the highest qualified bidder. Small sales may be made at cost, and settlers, farmers, and other bona fide residents in a national-forest community may obtain free timber for their own use where its removal aids in the protection or improvement of the forest.

In every timber sale the purchaser must agree to cut according to specifications prescribed by the Forest Service. Cutting methods required are such as to insure the cut-over areas being left in good condition for future growth. No cutting is permitted that would seriously injure watershed or recreational areas. Scenic and recreation values are the dominant considerations along heavily used roads and highways and in water-front zones.

The Sustained-Yield Unit Act, passed by Congress in 1944, authorized the Forest Service to enter into long-term agreements with willing owners of private timberland for the joint management of both private and public timber under sustained yield. In such a case, a designated tract of national-forest timber and the adjacent or intermingled private timberland will be handled as a unit. Local industry dependent on raw materials from those timberlands will thus be assured of continuous operation. The assurance of a continuous supply of timber permits the industry and the community to plan for permanency and to develop maximum utilization of the available timber resource. This greatly helps to insure both continuity of employment and maximum volume of employment.

The timber output from the national forests has increased rapidly in the past few years. Last year's total cut of over 3¾ billion board feet was almost treble that of 10 years ago.

The yearly cut can be increased still more. Production is not yet up to full sustained-yield capacity on many of the national forests. Substantial areas of mature and overmature timber in the West are still inaccessible and cannot be harvested until access roads are built. In the overmature stands little new growth accrues because growth is largely offset by losses from decay and other natural causes. With proper cutting practices, harvesting the mature and overmature timber will make room for new growth and growth of thrifty younger trees; instead of remaining in a near-stagnant condition, the stand will once more be growing timber.

On other national-forest areas, timber growth is being brought back on lands denuded in the past. But it will be some years before the timber is big enough to cut. And in many places where timber is accessible, mature, and ready to cut, the Forest Service has been unable to prepare timber sales fast enough to meet the demand. Information on the amount of timber that can be cut annually, areas most in need of cutting, and the transportation system required for the most economical harvesting and for continuous management is needed for many national-forest areas. Before a sale can be made, there must be a detailed examination of the area, the supplementary road system to be constructed by the purchaser must be laid out, a determination must be made as to how the timber is to be cut, and an appraisal, contract, and advertisement prepared. Because of limited funds and personnel available for such work, advance preparation of timber sales has not kept up to the desirable level. It would be good business for the United States to advance the funds needed to speed up national-forest timber-sale work. It would help in meeting the Nation's present heavy timber requirements; and each dollar spent for national-forest timber management brings back several dollars to the Treasury.

With more access roads to open up inaccessible stands, and with more personnel to prepare and supervise timber sales, it is estimated that the sustained output of timber from the national forests can be increased more than 50 percent within a few years—from the present cut of under 4,000,000,000 feet a year to at least 6,000,000,000 feet. Eventually even greater timber production can be obtained. Achievement of maximum sustained timber production will require adequate control of fires, insects, and diseases. It will require timber-stand-improvement work to speed growth and improve quality. It will require reforestation of denuded lands. Some 3,200,000 acres in the national forests requires planting to bring the land back to productivity; and there are additional areas so understocked that fill-in planting is needed.

In handling the national-forest timber resources the Forest Service is working toward intensive management for maximum continuous production. Intensive management includes systematic harvesting of mature timber. It includes close utilization to get as much usable wood as possible from the trees cut, and to avoid waste. It includes use of management practices and cutting methods that safeguard immature trees and assure the start of new growth. It includes silvicultural treatment of young stands—such as thinning and “weeding”—to speed the growth of desirable trees. Demand for such materials as posts, poles, and pulpwood is now making possible the accomplishment of some thinning and stand-improvement work through commercial sales. Where this can be done, faster and better timber growth is obtained, and the work pays for itself besides. But stand-improvement work on many forest areas would be a good investment for the future in any event.

Large structural timbers, highest quality lumber, some kinds of veneers and plywoods, and certain other specialty products can be made only from large sound trees. As the old-growth forests are used up, high-quality timber for these special products will become

scarcer. It takes a long time to grow high-quality timber, and the national forests can do a special service in assuming a substantial part of the country's future production of big timber and high-quality material.

Not all national-forest land is capable of producing commercial timber. More than half is of noncommercial forest types, such as alpine, semiarid, or chaparral. These noncommercial forest lands usually are extremely important watershed lands. Many are also valuable for grazing, wildlife, or recreation; and they may supply some low-grade products, such as fence posts and fuel, perhaps, but they are not a source of lumber, pulpwood, or other major timber products.

Of the 461,000,000 acres in all ownerships classed as commercial forest land in the United States, 73,000,000 acres, or about 16 percent, is in the national forests. But the national forests now contain more than 30 percent of the Nation's total volume of standing saw timber. The national-forest timber is becoming more and more important in meeting the country's needs for forest products. Many sawmills that formerly had supplies of private timber are now wholly dependent on national-forest timber to keep going.

With only 16 percent of the country's commercial timberland, the national forests cannot by any means supply all of the Nation's requirements for wood. We must look to forest lands in all ownerships, and mainly to those in private ownerships, to meet our needs.

But the national forests will be a big help in carrying us through until the country's total saw-timber growth can be built up. And they will be just as important permanently as in this interim (which may be a long time). Managed for sustained yield, the national-forest timberlands will be a never-ending source of timber, a permanent support for many local industries and the communities dependent upon those industries, and a backlog of security in the Nation's future.

Forage

In the national forests of the Western States there are many mountain meadows, stringers and pockets of grassland in the timber, open woodlands where grass or browse plants grow between the scattered trees, and other areas that are used for the grazing of livestock. In the Southeast many "piney woods" areas in the national forests can be grazed.

All told, some 80,000,000 acres of national-forest lands are suitable for grazing. Most of these national-forest grazing lands are in the West. They are only a small part of the 728,000,000 acres of western range, but they play a highly important part in the western livestock economy. Generally at the higher elevations, the national-forest ranges provide green forage during the summer months, when other suitable range is limited. They thus help to carry livestock herds through the summer season and produce grass-fat stock for the fall markets. In the Southwest, some national-forest ranges can be grazed year long.

Adjoining or surrounding many of the western national forests are public-domain lands that are administered as grazing districts by the Bureau of Land Management of the Department of the Interior.

The national-forest ranges, the grazing districts, and the private ranches in the vicinity all supplement each other, and are interrelated parts of the western livestock picture. A typical rancher may run his cattle or sheep under permit on national-forest range during the summer months and carry them through the winter on grazing-district land or on pasture or feed lot on his own ranch.

When the Forest Service was assigned responsibility for administration of the national forests one of the toughest problems it took on was the grazing use. Previously grazing had been unrestricted; there had been constant conflict between users of the range; too many arguments over range had been settled by the six-shooter; far too many livestock were running in the forests; and many of the ranges were already badly overgrazed. The Forest Service undertook to bring order out of this chaos, to set up an equitable system of allotment of grazing privileges, and to bring grazing use into balance with sustained forage growth.

National-forest grazing policies are clearly defined. The home builder is given preference in grazing privileges over the itinerant stockman or speculator. Stability of livestock operations is promoted through long-term permits and renewal preferences to established permittees. "Economic units" are encouraged—livestock operations large enough so that the rancher can make a good living but not so large as to create monopoly. Grazing fees are adjusted yearly in relation to livestock market prices, according to a formula worked out in cooperation with the livestockmen's associations. Where substantial adjustments in permitted numbers of stock must be made, they are made gradually to avoid sudden or drastic upsets in the permittee's operations.

The demand for grazing privileges greatly exceeds the amount of national-forest range available. The Forest Service is under constant pressure to let in more stock, and it is under pressure from stockmen who now have grazing privileges to convert those privileges into vested rights. But, in spite of all these pressures, there is a conservation job to be done—to build up and maintain the national-forest ranges as a permanent resource.

At least half of all the national-forest rangeland allotments are now in good condition. On the remainder further improvement or adjustment is needed. Some of the ranges are still overstocked. On these the Forest Service program of adjustments has not moved fast enough to prevent progressive deterioration of the range. This may have been because the grazing capacity of the range was overestimated, or because the Forest Service leaned over backward to avoid causing hardship to permittees dependent upon those ranges. But, in any event, where serious problems of range deterioration exist, decisive action must be taken to save the range.

When a cow has to walk several yards from one bite of grass to the next it does not put on weight very fast. On some overgrazed ranges it now takes 50 to 100 acres or more to support one cow through a grazing season. If such ranges can be brought back so that 2 cows—or 5 or 10 cows—can graze where 1 cow grazed before, the livestock industry will benefit, and so will people who would like to eat meat.

Nevertheless, some stockmen, understandably enough, are loath to accept any reductions in numbers of livestock on the forest ranges,

even though the reductions are made for the benefit of their allotted range.

Most western national-forest ranges are important watershed lands. Other people of the West, therefore, also have a vital stake in these lands—in seeing that the watershed values are protected, that erosion and siltation of reservoirs are prevented, that water is conserved, and flood danger kept to a minimum. Range conditions may affect irrigation farming, water tables, power developments, stream flow, and town and city water supplies over large areas in the Western States.

Many national-forest ranges also have recreation values and wildlife values. Sportsmen and recreationists therefore have an interest in these lands. In the management of these ranges the Forest Service must consider all these interests—the immediate and long-term interests of the livestock industry, the sportsmen and recreationists, the water users, the welfare of local communities, and the whole economy of the western regions. On all counts the situation calls for keeping the ranges permanently productive where they are already in good condition and for restoring forage growth and good watershed conditions where deterioration is under way.

Forest Service research has developed methods for successfully reseeding certain types of damaged ranges in several of the western regions. Reseeding of depleted ranges and getting them restored to productivity in some cases has increased the grazing capacity as much as 10 times. The Forest Service is carrying on reseeding operations on worn-out range as rapidly as funds become available. On many deteriorating ranges a rest period from grazing or a reduction in stocking may allow forage growth to come back naturally. In other cases more fences or development of watering places for stock, to obtain better control and distribution of the stock on the range, may be all that is needed to bring grazing in balance with forage growth.

In colonial days many New England villages set aside a community pasture or “common” where local people could graze their livestock. Range areas in the national forests of the West are in a sense public grazing commons for the western communities. As the manager in charge, the Forest Service is endeavoring to handle the distribution of grazing privileges on these areas fairly and equitably, and administer the forest ranges in the best long-term interests both of the grazing users and of the whole public. Where the desires of a single user conflict with the public interest, the public interest of course must come first.

In the national forests of the Southeast, grazing use thus far has been a less complex problem. It involves mainly the coordination of grazing use with timber growing, and the development of techniques for obtaining best use of forage values.

In the multiple-use management of the national forests grazing has an important place. The national-forest forage resource can contribute materially to the Nation's production of meat, wool, and leather. This forage crop should be utilized; and it should be sustained. The Forest Service objective is to develop the range resources of the national forests for maximum permanent production and use in the interest of a stable, prosperous livestock industry, with full protection of watershed values and other values and services in the public interest.

Wildlife

Our national forests are the home of well over 2,000,000 head of deer, elk, and other big-game animals—about one-third of the Nation's total big-game population. In the Western States about 70 percent of all big game lives part or all of the year in the national forests. These public forests furnish the habitat for countless thousands of small-game animals, upland birds, and fur bearers. Much of the Nation's best trout waters (90,000 miles of unposted streams and 1½ million acres of fish-producing lakes) are found in the national forests. In the aggregate, our national-forest system constitutes one of the largest areas of public hunting and fishing ground in the United States.

All this represents a wildlife resource not only of recreational value and scientific value, but of great economic importance as well. Last year the national forests were host to more than 4½ million hunters and fishermen, who spent a total of more than 16½ million man-days in the field. Their catch was a not inconsiderable contribution to the Nation's food larder. On the average, for each day in the field, each sportsman spent several dollars for equipment, food, gasoline, and other expenses—money which helped support industries and many local small business enterprises and thus helped to provide employment and income for many people. The income to a number of States from sale of fish and game licenses is largely based on the hunting and fishing opportunities provided by the national forests.

Management of the wildlife as a permanent resource in the interest of good hunting, good fishing, and other forms of enjoyment and use is part of the multiple-use program of national-forest administration. The Forest Service aim is to produce the maximum amount of wildlife consistent with the needs for other essential resources and the requirements of watershed protection.

It is Forest Service policy to cooperate with the States on matters pertaining to wildlife on the national forests. The State fish and game or conservation departments assume responsibility for protection and utilization of the resource and may also conduct research on forest wildlife. State regulations as to licenses, seasons, and bag limits apply on national-forest lands, except on Federal refuges or similar designated areas. In many of the forests State authorities and the Forest Service are cooperating in special wildlife-management projects.

The Fish and Wildlife Service of the Department of the Interior takes Federal leadership in fundamental research to determine the principles upon which wildlife management plans may be based. That agency also may act in an advisory capacity to the Forest Service in the carrying out of such plans and principles.

The Forest Service works with the States on management and utilization activities. Many national-forest rangers are deputized as State wardens and aid in the enforcement of State game laws on national-forest lands. Forest officers keep track of trends in wildlife populations, make habitat surveys, and advise with the State authorities as to proper seasons and bag limits. Forest Service research in forest and range management often has a direct bearing on wildlife-management practices. The main function of the Forest Service, however, is to provide and maintain a favorable habitat upon which wildlife can be produced.

Thus the Forest Service, the Fish and Wildlife Service, and the State fish and game departments all have distinct and important roles to play. Through carefully arranged and coordinated cooperative procedures their programs are made complementary to each other, with little or no overlap or duplication.

In creating and maintaining a healthy wildlife habitat, the Forest Service must develop ways and means for integration of wildlife use with other normal forest uses so that the forests and ranges are kept in a productive condition. Plans are necessary, for instance, to insure that wildlife food and cover are not destroyed during timber-stand improvement or logging operations on the one hand or that excessive game populations do not destroy important timber values on the other. In general, orderly, sustained-yield logging of timber fits in well with wildlife management. It provides a large aggregate amount of open spaces and forest "edge" where the choice game food plants grow. Dense, unbroken timber stands support relatively little game.

On livestock ranges use of forage by domestic animals must be balanced with use by game. There is less conflict between the two than might be expected, however; and where conflicts do occur it is usually a case of overstocking, either with livestock or big game, or both, in relation to natural food supply.

The Forest Service also can carry out certain practices aimed directly at habitat improvement and maintenance. It can improve food and cover conditions by such means as selective thinning of timber, creation of openings in dense stands, planting of food trees and shrubs, and development of watering places. For maintenance of sport fishing it must frequently improve streams and lakes and stabilize banks and shores.

The Forest Service recognizes the interests of the scientist, the camera hunter, and the nature lover as well as those of the sportsmen in national-forest wildlife. Hunting may be restricted in picnicking and other special recreation areas. There is provision for setting aside certain areas to safeguard rare or vanishing species. A special area has been set aside in California, for instance, to protect the nesting sites of the near-extinct California condor, largest of the North American birds.

When the Forest Service began administration of the national forests, game populations in most places had been seriously reduced. Many States had no modern game laws, and there was little control of poaching in many of those that did. The Forest Service encouraged the establishment of nonpolitical game commissions in the States and the enactment of sound game laws. In cooperation with the States many transplants of deer, elk, beaver, and other species were made to restock depleted areas. Since 1921, when the first country-wide national-forest estimate of game population was made, big-game numbers have nearly quadrupled. The greatest increases have been in deer and elk. Moose, bear, and mountain goat have shown more moderate increases. Only bighorn sheep, among the principal big-game species, have declined, but these now seem to be holding their own.

Until recently the national-forest deer population was doubling itself every 10 years. During the past few years, however, it has become apparent that the era of big annual increases is about over. Many of the big-game ranges are now fully stocked or in some instances overstocked, and a leveling off in numbers is to be expected. Problems

of overpopulation have arisen in some areas, although there are still opportunities elsewhere for increases in game.

Where overpopulation exists, Nature might eventually correct it. But Nature would do it in a cruel way, and wastefully. The deer or elk would eat up their natural food supply, and then the herds would be decimated by starvation and disease. The range would be so depleted that it could support little game for years to come. The Forest Service believes that a better way to solve problems of overpopulation is to bring game numbers into balance with their range by carefully regulated hunting. In cooperation with the States the Forest Service is improving conditions on a number of areas of overconcentration. But on the overstocked areas where herds have not yet been reduced, as well as on many areas where reductions have recently been made, there is still much deteriorated range that is in urgent need of rehabilitation.

The Forest Service is faced with an increasing demand for hunting on the national forests. This use has increased to unprecedented totals since the war, and indications are that it will continue to increase for some time. The Forest Service must determine the legitimate demands for game in relation to other resources, and the grazing capacity available to it, and then work closely with the States in seeing that carrying capacity and game numbers are kept in proper balance.

During the war, when efforts had to be concentrated on other activities, the Forest Service discontinued practically all wildlife operational projects. A big backlog of needed work and of critical maintenance of prewar developments piled up. No funds have been appropriated directly for wildlife work during the past 2 years, and the backlog is still growing.

The Forest Service, however, will continue its efforts for full development and maintenance of the wildlife resource, in relation to other resources, on the national forests, for its scientific and recreational values, for good hunting and fishing, and as a continuing contribution to the economic support of local communities.

Recreation

All national-forest lands are open for recreation. A visitor may go anywhere and stay as long as he wishes. The only exceptions are certain small areas within the forests that may be restricted for special purposes, or areas of high fire hazard that may be closed to entry during periods of fire danger. In some heavily used areas a camper's stay at any one camp ground may be limited to a week or two so as to give others a chance.

Within the national forests are many scenic attractions and places of other special interest which attract the tourist-sightseer type of visitor. The bulk of the recreational use, however, is by those who come to the national forests for recreation in the truest sense—for rest and play, for the enjoyment of outings in the forest environment.

Many facilities have been provided for this recreational use. The Forest Service has developed 4,500 camping and picnicking areas, where tables and benches, fireplaces, safe water supplies, toilets, and garbage-disposal facilities are available. Trailer parking sites are available in many places. Hundreds of swimming holes and beaches have been improved.

The 230 winter-sports areas that have been developed on the national forests include many of the most popular areas in the country. The higher western ranges provide the terrain, snow conditions, and climate which are helping to make skiing a national sport of major importance. The Forest Service develops the public-use areas and some public shelters, and permits private capital to install ski lifts, ski tows, restaurants, and lodges.

There are 400 organization camps, provided with dormitories or cabins, mess halls, and other facilities for group outings. Some of these are maintained by the Forest Service and made available to civic and welfare organizations sponsoring low-cost vacations for underprivileged children; others are maintained under free permit from the Forest Service by municipal welfare agencies, Boy Scouts, Girl Scouts, and other civic groups.

More than 50,000 miles of national-forest highways and secondary roads are available to the motorist. Thousands of miles of hiking and horseback trails are sign-posted and maintained.

Numerous commercial resorts and cabin camps operate under special-use permit from the Forest Service. Permits also are issued for the use of sites on national-forest land for operation of stores, restaurants, service stations, ski lifts, horse-rental and boat-rental establishments, and other commercial facilities serving the vacationing public. A number of dude ranches operate within or near national forests and feature trips in the forests for their guests. In some of the national forests individuals may lease sites where they can put up their own summer cabins.

The Forest Service manages the recreation resource of the national forests with the least possible restriction of public use consistent with the safety of the public and the protection of the forest. It endeavors to provide abundant recreation opportunities for all—for those with slim pocketbooks as well as those with fat pocketbooks. Public recreation facilities have first priority. Private uses, such as summer-cabin sites for individuals, are permitted only on areas where there is no foreseeable need for public use. Modifications of the national-forest environment are kept to a minimum, and necessary developments and facilities are designed to be in keeping with the forest environment.

To preserve for all time representative examples of the American wilderness, the Forest Service has set aside 77 wilderness areas, wild areas, and roadless areas within the national forests. These areas total some 14,000,000 acres—an area larger than New Hampshire and Vermont combined. They are maintained in substantially primitive, unmodified condition. Commercial timber cutting is not permitted, but since most of the areas are in high country with low commercial timber values, setting them aside has not actually withdrawn any great amount of usable timber from harvesting. Some regulated grazing by livestock may be allowed. The areas will be kept roadless, accessible only by trail or water. Many of them are the home of fine big-game herds. Among the last remnants of the wilderness in America, they will continue to provide opportunities for the enjoyment of wilderness recreation—for those who yearn for solitude or who want really to "rough it."

The Forest Service believes that access to the national forests for recreation should remain, as it is now, free to the public. But there is

some question as to whether some of the special services and facilities now provided should continue to be furnished without charge. It costs the Government—i. e., the taxpayers—quite a bit to provide some of these services. For example, at some heavily used swimming places, the public safety requires that a lifeguard be on duty. Part-time or full-time custodians must be kept at many of the camp and picnic areas to maintain facilities, check vandalism, dispose of garbage, etc. Moderate charges for the use of some of these special facilities and services could help to offset their costs. The Forest Service is exploring this question—whether recreational use in the national forests should pay at least some part of its own way.

Recreational use of the national forests is steadily increasing. The number of recreational visits in 1947 reached a new high, 21,000,000. Average length of stay per visit was 1.6 days. Because the same person may be counted more than once if he visits other forests or makes a repeat visit to the same forest during the season, the Forest Service reckons recreational use in terms of "visits" rather than visitors. The 21,000,000 visits by recreationists did not include some 56,000,000 additional visits made by motorists out to enjoy the forest environment or sightseers passing through.

The major portion of the recreational use is confined to less than 1 percent of the national-forest area. Improved camp and picnic areas, winter-sports areas, organization camps, summer homes, and resorts occupy only 146,000 acres, but these areas received 13,000,000 out of last year's total of 21,000,000 recreational visits. That means an average of 89 visits per acre, or 142 days' use per acre per year—certainly a heavy use of the land. The other 8,000,000 visits were to other forest areas, by hunters and fishermen, wilderness travelers, etc.

This heavy public use is overtaking many existing national-forest recreation facilities and making the job of clean-up and maintenance very difficult. Many popular areas are regularly overcrowded during the vacation season. Overcrowding reduces the enjoyment of those using the area. It may also spoil the area for future recreational use. Attractive ground cover is destroyed, dust accumulates, even mature trees are weakened and killed.

The appropriations available for recreation work have been insufficient to do more than maintain essential sanitation and fire-protection facilities and keep the recreation areas usable. Since the war there have been virtually no funds available for development of additional public recreation facilities to relieve the overcrowded conditions on existing areas. Most of the present recreation developments in the national forests were constructed during the 1930's with Civilian Conservation Corps labor and funds. Then came the war and maintenance and development work was largely suspended. Many facilities have deteriorated beyond repair, and it is becoming increasingly difficult, as the facilities get older, to keep essential things in good, safe operating condition.

Recreational use, like the use of other national-forest resources, has economic values of considerable importance to the local communities. For many towns and cities in the vicinity of the forests, the tourist and vacation business is a major source of income. The long-term program of the Forest Service calls for building up and main-

taining the national forest recreation resource, so as to contribute permanently to the welfare of local communities and provide abundant opportunity for healthful outdoor recreation for the people of the United States.

Water

Watershed protection is a basic consideration in all national-forest management programs. To secure "favorable conditions of water flows" was one of the stated purposes in the 1897 Act, which provided for administration of the forest reservations. Public concern about floods was largely what led to enactment of the Weeks Law of 1911, authorizing Federal purchase of watershed lands.

In the West, national forests are at the headwaters of most of the major rivers and streams. National-forest lands are the source of water supply for hundreds of towns and cities, for many of the industrial plants, power projects, and irrigation farm developments on which the economy of the Western States largely depends. East of the Great Plains, where national forests are fewer and farther between, they do not bulk so large in the total water-supply picture. But the national forests of the Ozarks, the Appalachians, and other important watershed areas are of vital significance in local and regional water-supply and flood-control considerations.

Our Nation's water supply is a problem of growing concern. Instances of depleted or reduced ground waters are increasing across the land. Diminished water yields are becoming more apparent each year in a number of areas. Lowered water tables are developing from the Pacific Northwest to southern California, throughout the entire Southwest, in the Plains areas, and eastward into the Allegheny and Blue Ridge flood plains. Salt-water intrusions occur intermittently along the Atlantic, Pacific, and Gulf coastal regions. Further agricultural, industrial, recreational, and municipal developments are at an impasse in many areas unless additional water can be obtained. At the same time vast amounts of water are wasted and terrific damage is done each year by floods. The management of our watersheds for reduction of flood danger and for maximum production of usable water is of the utmost importance.

Our watershed problem involves many farm lands and vast wild-land areas both in public and private ownership. Through its efforts to promote good forest and range management generally, and in various cooperative programs with other Federal and State agencies, the Forest Service is endeavoring to help bring about improved conditions on watershed lands in all ownerships. Furthermore, it has direct responsibility for watershed management on some 180 million acres of national-forest land.

Watershed protection therefore must be tied in with all timber management, grazing management, recreation, road construction, and other activities on the national forests. In some localities, it is the paramount consideration. Where critical watershed values are involved, other uses must be restricted to the extent necessary to protect those watershed values. Usually, however, regulated timber harvesting and grazing use can be carried on without serious impairment of watersheds. Research is developing techniques by which timber cutting can be better coordinated with watershed protection; in some cases it can actually be made to improve watershed conditions.

Fire control is extremely important. With increasing realization of the importance of watershed cover and with growing needs for national-forest water, it has become apparent that standards for intensity of protection must be raised in many areas. It may be even more important to protect the "worthless" brush on an area of high watershed value than a stand of choice timber on an area of low watershed influence.

As a result of fires, overgrazing, or other causes, there are still too many watershed sore spots in the national forests. On these critical areas special improvement work is needed—such work as contour trenching, road stabilization, stream-channel and bank stabilization, construction of small dams to check erosion gullies, reforestation, or revegetation.

As rapidly as it can with present funds available the Forest Service is making intensive watershed studies on individual national forests. These studies determine actual and potential water yields, soil conditions, cover conditions, present and prospective water requirements of the tributary communities, and other factors. The studies will provide a sound basis for long-term watershed-management plans aimed at building up and maintaining good watershed conditions and conserving national-forest water resources of fundamental importance to local and national welfare.

These, then, are the major resources of our national forests—timber, forage, wildlife, recreation, and water. There are others. Mineral deposits exist in many of the forests, and, except for certain reserved areas, national-forest lands are open to prospecting and location of mining claims. A variety of other products are available, such as gum naval stores, fern hay, peat moss, and Christmas greens.

The major resources are renewable resources. Under sustained-yield management they can be produced in perpetuity. Under the multiple-use system of administration, their uses will be coordinated and balanced one with another, for the greatest total of returns.

COSTS AND RETURNS

It is always pertinent to ask about the costs. What are the costs of national-forest administration in relation to returns?

For operation, management, and protection of the national forests last year the Forest Service spent approximately \$32,000,000. In addition, approximately \$13,000,000 was spent from appropriations by Congress for roads and trails and for purchase of land. Part of these expenditures can be classed as capital investments.

The yearly operating costs are not large in comparison with many governmental activities and many private industrial enterprises. They represent less than one-hundredth of 1 cent of the tax dollar. Furthermore, they are offset in large part by national-forest receipts, which last year totaled nearly \$25,000,000.

Nevertheless, the Forest Service aims at getting a dollar's value for every dollar spent. It is proud of its reputation for efficiency; and it is constantly working to attain even greater efficiency, through management studies and controls, decentralization and delegation of authority, and in-service training of personnel. Job-load-analysis

studies conducted by the Forest Service have received favorable attention from industrial-management experts and other Government agencies.

Many of the national forests more than pay their own way—that is, cash income exceeds operating costs. On others, especially those containing large areas of cut-over and burned-over land recently acquired, receipts may be expected to increase as new timber growth is built up. A substantial amount of national-forest land, however, will probably never produce much cash revenue. Areas above timber line and such noncommercial forest lands, for example, as the chaparral forests of southern California are largely of non-revenue-producing character. The costs of protecting some of these areas are nevertheless very high, but vital watershed and other values make protection a necessity, and the benefits exceed the costs many times.

Timber sales, grazing fees, and special uses account for most of the cash receipts. National-forest receipts go to the United States Treasury; they cannot under existing law be applied toward meeting operating costs. With only minor exceptions, all funds for national-forest administration and development must be appropriated by Congress, and the funds appropriated are specified for particular uses.

Each year, however, an amount equal to 25 percent of the receipts goes to the counties containing national-forest lands. The counties' share of national-forest receipts is used for local roads and schools. An additional 10 percent of receipts is allotted for expenditures on national-forest roads in the States of origin, so that the States and counties get the direct benefit of 35 percent of national-forest gross receipts.

Although national-forest income has steadily increased and may be expected to increase still more, it may not equal the costs of administration and annual capital investments. Many of the national-forest activities are nonrevenue producing. Most recreation facilities are provided for the public free of charge. Roads and trails are constructed and maintained for the benefit of the public. Wildlife-management work brings in no direct returns, although the cash spending of more than 4,000,000 hunters and fishermen who utilize the national forests each year means an important source of income to local business, and the income to many of the States from sale of fish and game licenses is based largely on the hunting and fishing opportunities provided by the national forests. Watershed-management work likewise produces no revenue, but the value to local communities and the Nation in terms of flood control and safeguarding of water supplies is inestimable.

It would be difficult to value such services in monetary terms. The objective of the national-forest enterprise, however, is not profit but public service. Undoubtedly the returns in public benefits each year are far greater than the costs.

DEVELOPMENT FOR MAXIMUM PUBLIC SERVICE

With full development, the benefits of the national forests to the people of the United States can be greatly increased. What is needed for development of the national-forest system for maximum public service?

A Stepped-Up Program of Management and Improvement

Some major needs already have been indicated. They include more intensive timber management, measures to build up ranges, more intensive wildlife management, more recreation developments, and intensified watershed management.

Timber-management needs include more access roads, more timber-stand improvement work, more planting, more intensive control work on forest insects and diseases, and more personnel for preparing and supervising timber sales.

Building fences, developing water supplies, improving stock drive-ways, controlling destructive rodents, and getting rid of poisonous plants are activities that will help to restore and develop forest-range resources. Reseeding has immense possibilities for large-scale restoration and improvement of forage yields.

There is need for a great deal of wildlife-habitat-improvement work, especially on areas damaged by too heavy concentrations of big game. In fishing waters, stream-improvement work, such as protection of spawning places and building small dams to create trout pools, can provide better fishing.

There is need for more ski trails, swimming places, camping and picnic grounds and safe water supplies for them, and for more administrative and custodial personnel to handle the steadily increasing use of national-forest recreation facilities.

Watershed-improvement work is needed on critical water-source areas; and intensive surveys are still needed for many watershed areas as a preliminary to the actual protection work.

To back up such resource management and development work, many improvements and facilities for general administration and protection are needed: Replacement of unsafe lookout towers; improvement of telephone and radio communication systems; surveying and mapping; more and better housing for national-forest personnel. Roads are needed not only for access to timber stands but for fire protection, recreational use, and proper management of the forests. Many national-forest roads are important links of main transcontinental highways or of the State highway systems. The planned road and trail system for the national forests includes some 37,000 miles of roads and 21,000 miles of trails as yet unconstructed, in addition to 103,000 miles of roads and trails now of unsatisfactory standard.

Most of these things mean more money and more manpower. Forest-protection work, however, such as expansion of fire-control facilities, insect control, and the like, is insurance against loss of existing values; and insurance against possible loss is generally considered good business. Forest-improvement work—tree planting, timber-stand and range improvement, development of recreation facilities, etc.—is a capital investment that will pay future dividends either in increased yield of products or in other services and benefits.

The Forest Service is confident that it can continue to make expenditures for national-forest improvement and development yield handsome returns in community benefits and contributions to the economic welfare of the Nation.

Stability for Public Ownership

Some 155 million acres of national-forest land is public domain which was reserved for national-forest purposes by Presidential proclamation under the Act of March 3, 1891. The status of these public conservation lands is not as secure as it might be. Certain types of use, legitimate and desirable as such, may be authorized on national forest lands without the consent of the agency in charge of those lands. Large areas of national forest land may be flooded under the Reclamation Act with no provision for giving the Secretary of Agriculture any voice as to whether even greater public values may be destroyed. The Mineral Leasing Act of 1920 gives the Secretary of the Interior the right to lease national forest lands for exploitation of certain minerals, including oil and gas, also without consent of the Secretary of Agriculture.

No one will wish to prevent the utilization of mineral, reclamation, or hydroelectric power values needed by the United States. Under the Forest Service policy of the greatest good to the greatest number in the long run, the utilization of valuable mineral resources and the impounding of water for reclamation or power will always rank high among uses of national-forest land. But there should be provision for development in such a way that these necessary resources can be obtained without needless damage to watersheds, timber, recreation, or other values.

The General Mining Laws give any individual the right to locate, enter, and patent national-forest land in most places upon discovery of mineral values (except for the eight minerals covered by the Mineral Leasing Act) sufficient to justify development of the claim. The law makes no requirement that mining be done on the land after patent, and it provides no checks on damage to soil, timber, water, or other values. If, after patent, it becomes evident that the minerals are not commercially valuable, the patentee may still retain title to both surface land and subsurface. The law is vulnerable to abuses deplored alike by public land administrators and bona fide miners; and the case histories of many mining claims show that mineral development has not been the end result. There are also examples of mining activities which are decidedly contrary to the public interest. In many instances the cost to the public far exceeds the gain to the mining operator.

The search for oil and gas and other minerals is being intensified by shortages. As the more valuable deposits are depleted, less accessible and poorer quality deposits will become commercially valuable. Exploitation of deposits of oil shale and low-grade coal, which underlie large areas of national-forest land, may develop before many years.

All these things mean an insecure basis for sustained-yield forest management, and for maintenance of public resources and properties in which millions of dollars have been invested and for protection and development of which millions are being spent each year.

The over-all public interest should be the criterion in the disposal of public resources. There are lands of the United States on which mineral utilization is unquestionably the best use of the land; there are other areas having mineral values on which other values are undoubtedly higher. The decision as to whether or not a certain area is more important as a reservoir site for irrigation or power, as a mining

site, or as public timber, grazing, or recreation land cannot be decided by evaluating only one resource. It requires a comparison of all present and future public values to determine which use yields the greatest net public return in the long run.

Often reasonable restrictions will make possible utilization of a resource without impairment of other values. Location of an unrestricted mining claim, for instance, on the watershed source of a large city's water supply might be disastrous, because the claimant would not be bound to consider the requirements of the city. But the utilization of mineral values under permit, suitably controlled to protect the city's water, might be possible without seriously reducing the profit of the enterprise.

On those national-forest lands acquired by purchase under the Weeks law, as differentiated from those withdrawn from the public domain, the status of public ownership is a bit better. Weeks-law lands also may be leased by the Secretary of the Interior for exploitation of minerals, but the consent of the Secretary of Agriculture is required. The Secretary of Agriculture also is given the right by law to attach such conditions to his consent as may be necessary to safeguard national-forest land values for the primary purposes for which they were acquired and are being administered. The lessee's operations are controlled and he pays a just price for the privilege of exploiting a public resource. The extensive operations of several major oil companies under these provisions prove that unrestricted title to the land surface is not essential to successful mineral operations. The safeguards that protect the public interest in regard to mineral leases on national-forest lands acquired under the Weeks law might well be applied to the national-forest lands reserved from the public domain. Similar provisions would be appropriate in the case of other uses not now subject to approval of the Secretary of Agriculture.

The whole national-forest resource program should be superior to exploitation of any single resource, and the decision as to whether any single use is of sufficient national importance to justify interference with the over-all national-forest objectives should rest with those responsible by law for carrying out those objectives.

Consolidation and Extension

Within the established boundaries of most national forests are numerous tracts of privately owned land. Indeed, in several of the western national forests the pattern of ownership is like a checkerboard, because each alternate square mile passed out of public ownership as a result of early land grants to the railroads. In national forests established through purchase of lands under the Weeks law, Federal ownership is often spotty because the land-purchase program is far from completed.

Such spotty or checkerboard ownership causes many problems in national-forest administration and protection. The uses to which intermingled private lands are put often interfere with or nullify sustained-yield timber management, watershed protection, or other national-forest objectives. It costs a great deal of time, effort, and money for establishment of rights-of-way for the movement of

national-forest resources and the development of roads, trails, telephone lines, and other requisites of effective forest management.

The exterior boundaries of existing national forests and purchase units include, all told, some 49,000,000 acres that are in other than Federal ownership. Of such lands, approximately 14,000,000 acres appear to be more suitable for other purposes than public forest and are likely to remain in private ownership. The remaining 35,000,000 acres are generally of the same types and have the same potential uses as the national-forest lands. For effective development of the national forests, these intermingled lands should be acquired and managed as integral parts of the forests.

There are also some areas of land adjoining the present boundaries of national forests that should be included in the public forests. These marginal-fringe lands, most of which are now cut over, are logical parts of national-forest watershed or timber-management units; and their present exclusion from the national forests adversely affects the protection, management, and development of the national forests in much the same way as the spotty character of public ownership within the forest boundaries.

Land may be acquired for national-forest purposes through exchange of national-forest land or timber for privately owned land, through donation, or through purchase. Land exchanges are effecting many desirable adjustments of ownership between the public and the owners of private property within forest boundaries, to the advantage of both. A number of donations of land from public-spirited citizens are received each year, but though the donated tracts may be of special value for administrative sites or other purposes, they do not usually add up to much acreage. An adequate attack on the problem of needed consolidation of public ownership within the boundaries of the national forests and purchase units will have to be through Federal purchase of lands.

Appropriations for land purchase last year were enough to buy about 103,000 acres. The Forest Service believes that a greatly stepped-up purchase program would be in the public interest. It would make for more effective and economical management of the national forests and speed their consolidation and development so that they could more fully perform the functions for which they were established. It would be advantageous, too, if the appropriations for land purchases were made available at a more or less uniform yearly rate and could remain available until expended. Negotiations for purchase of lands could then be carried on in a more orderly, systematic way, rather than on a when, as, and if basis. A trained, experienced staff could be maintained to handle the purchase work efficiently and economically, instead of hurriedly building up a big staff for a large purchase program one year and disbanding it another.

State and county governments are sometimes reluctant to see lands purchased for national-forest purposes taken off the local tax rolls, even though much of the land that might be acquired now pays little or nothing in the way of taxes. Lands in national forests created from the public domain never were subject to tax. Nevertheless, the Forest Service feels that national-forest lands should contribute a fair share toward the maintenance of local governments. The 25 percent of yearly forest receipts that under present law goes to local county

road and school funds is apt to fluctuate considerably from year to year, and different national forests vary widely in amount of receipts. It is apt to be least when the need of the counties is greatest. Denuded lands acquired for national-forest purposes bring in few receipts during the period of restoration. Some method that would put the Federal financial contribution to local governments on a more stable and equitable basis would be desirable. It would help promote stability for local governments, and it would facilitate the purchase program for consolidation and development of the national forests.

Legislation enacted by Congress in 1948 provided for an annual Federal payment to the counties of three-quarters of 1 percent of the appraised valuation of the national-forest land within a specified area of the Superior National Forest in Minnesota. This system of annual payments based on a fair percentage of true value of national-forest property, instead of the 25 percent of receipts procedure, might well be applied nationally.

It is probable that our national security and welfare will eventually require a considerable expansion of public forest ownership. There are certain lands where acute problems of watershed protection or other vital public interests make public acquisition and management a virtual necessity. There are also some forest lands where the productivity is too low for private owners to be expected to hold them for timber growing. There are forest lands so denuded as to offer no prospect of income for many decades, and with little prospect of rehabilitation by private enterprise. And there are tracts of timberland now subject to destructive exploitation the liquidation of which would vitally affect the welfare of dependent communities. Measures necessary to maintain or restore the economic values of many such lands are not now in prospect or reasonably assured; and if these lands are to do their part in meeting the Nation's resource needs, instead of being carried as dead weight, public ownership may be the only answer. The importance of public ownership is increasing with the Nation's delay in adopting adequate forest-conservation measures.

Some of the forest lands acquired for public ownership may be better suited for management as State or community forests than as national forests. Where forest lands acquired for public ownership are in large tracts, include watershed areas of interstate importance, or involve large-scale jobs of restoration, development as national forests is generally indicated. Smaller, scattered tracts might be made State forests, or county and municipal forests. National, State, and community forests complement each other; all these categories of public forest ownership have a part to play in our national economy.

THE NATIONAL FORESTS' PLACE IN THE TOTAL RESOURCE PICTURE

In the development of our national-forest system the going has not always been easy. Some mistakes have been made. But the Forest Service feels it has reason to be proud of accomplishments to date. It is certain that with full support and cooperation of the American people the national forests can be developed for even greater public service.

What is the place of our national-forest system in the Nation-wide resource picture? How does it fit into our national economy?

At the foundation of our economy are the natural resources. Upon the soil, water, wood, grass, minerals, and other basic resources, all agriculture, industry, and trade depend. Only as those resources are maintained and wisely used will our Nation progress and prosper. Resources that are nonrenewable must be carefully husbanded; those that are renewable must be continuously renewed.

Under the law of the jungle, each individual seeks to obtain and control resources for his own exclusive use, to get as much as he can before another gets it. Under an autocracy or dictatorship, whatever the name or form or ideology on which it is based, one individual or group gains control of all resources, allowing to other individuals only such use and enjoyment of resources as may serve the purposes of the controlling group. We in America are seeking a middle way, a happy compromise between these extremes, a democratic form of society which seeks to preserve as much freedom of action for the individual as possible consistent with the common good. Through cooperative effort and through such rules and regulations as may be set up by mutual agreement, we must provide for the maintenance and wise use of our resources in the public interest.

In such a democratic society, public forests seem to be well-fitted. They are owned by the people and managed for the people. They include resources that may not be well-suited for profitable private enterprise but the proper management of which is essential to public welfare. Protection of water sources, for instance, is not apt to be a money-making activity, but it is vitally necessary in the public interest. Public management of forests may often be the best assurance of stability for communities dependent on those forests. Under public multiple-use management, all values of a forest area can be coordinately developed and managed, whereas the private exploitation of a single resource might be actually destructive of other resources of public value.

The national-forest enterprise is a cooperative endeavor, wholly in line with our democratic principles. Each citizen of the United States is a stockholder in our national forests. The citizens' representatives in Congress are the board of directors which sets up the broad objectives and policies and governs the expenditure of funds. The Forest Service has been placed in charge as manager on the ground. It is responsible to the stockholders for managing the enterprise in their interest and for production of regular dividends in the form of public benefits.

There are some who believe that all forest lands should be in public ownership. And there are some who say that all land should be privately owned. The Forest Service believes there is need for both public forestry and private forestry. Both have a place in our forest economy, and each can supplement the other.

With the increasing needs of a growing population for timber and the decline of private supply, and with increasing water problems in many areas, our national forests and other public forests undoubtedly will play an increasingly important part in the Nation's economy.

But even so, the public forests cannot do the whole job alone. Public forests—Federal, State, and community—now comprise only one-fourth of the country's commercial forest land area. The more acces-

sible and more productive forest lands are for the most part in private ownership. We must still rely on private lands for the bulk of our timber supply.

Many lumber companies, pulp and paper companies, and other industrial and individual owners of private forest land are doing a good job of forest management. But only 8 percent of all timber-cutting practice on private lands can yet be so classed. Twenty-eight percent is fair. Sixty-four percent is poor or destructive. Private forest-land resources as a whole are on the down grade. Timber is not being grown as fast as it is being used. Millions of acres of forest land are now poorly stocked or nonproductive. Many forest lands are seriously deteriorating from a watershed standpoint.

The Forest Service has repeatedly recommended measures to encourage better forest management on private lands—increased public aid in fire protection and insect and disease control; increased technical advice and assistance for forest-land owners, especially the small owners; public aid in the development of cooperative management and marketing associations of forest owners; provision for long-term, low-interest loans to help finance timber-growing enterprises; and more research on problems of timber growing and forest management.

The Forest Service also has repeatedly recommended public control of timber cutting and related practices on private forest lands, sufficient to prevent destructive practices and to assure that forest lands will be kept in reasonably productive condition. A plan for regulation by the States, with basic national standards, and with Federal financial assistance, has been proposed.

With adequate safeguards for the public interest in all forest lands, with encouragement to private enterprise in timber growing, and with full development of the public forests, our forest resources can eventually be built up and maintained to supply timber in abundance and to provide all the other benefits of well-managed, productive forests for all time.

THE YEAR'S WORK ON THE NATIONAL FORESTS

National Forest Board of Review

In May 1948 the Secretary of Agriculture established a National Forest Board of Review composed of private citizens to advise his office in the solution of problems arising in connection with use of the national forests by the public. The Board also will be called upon to advise on the disposition of appeals to the Secretary by forest users, such as, for example, stockmen who run cattle and sheep on national-forest lands under permit, from decisions by the Chief of the Forest Service affecting their operations.

Members of the advisory group were selected on the basis of personal competence and not as representatives of any group or organization interested in the use of national-forest land. It was stipulated that members must have no financial interest in the use of this land. The Board will meet at the call of the Secretary and will be paid a salary or per diem allowances for actual time served.

Those appointed as members of the Board were Dr. Jonathan Forman, of Columbus, Ohio; Prof. Gilmour B. MacDonald, formerly

head of the department of forestry, Iowa State College, Ames, Iowa; and Dr. Roland Roger Renne, president of Montana State College, Bozeman, Mont.

Timber Management

Production of timber.—Timber cut on the national forests in sales and exchanges totaled 3,758,885,000 board feet in fiscal year 1948, a slight decrease from the record high of over 3.8 billion feet in 1947. Receipts from timber sales, however, increased from \$15,400,000 to more than \$20,000,000, the biggest jump in receipts ever recorded.

Marked advances in timber-stumpage prices have occurred in practically all forest regions, but particularly in the Pacific Northwest and parts of the South. The Forest Service has followed a conservative policy in appraising stumpage for sale, but competitive bidding for better quality timber where stumpage is now in tight supply has driven prices upward. More than \$30 per thousand board feet has been paid for Douglas-fir in western Washington and more than \$60 a thousand for old-growth shortleaf pine in Arkansas. Forest Service stumpage prices are thus a result rather than a cause of present-day prices for lumber, plywood, and other forest products. The appraised value at which timber is advertised allows a fair margin of profit and risk to an operator of average efficiency at recently prevailing lumber prices and after allowance for the estimated costs of production. Exceptionally high bids are evidence of depletion of other sources of stumpage through overrapid cutting by too many mills within the areas where such prices occur.

The rate of access-road construction is now inadequate to meet the continuing demands for additional timber from the national forests. Since special financing of road-construction projects by the National Housing Agency terminated in December 1947, access-road building has been scarcely more than enough to maintain the present level of cutting.

At the present high level of demand for forest products, opportunities to sell low-grade materials as thinnings and salvage continue. But since much of the time and effort of the available Forest Service timber-sale organization must be put in on preparing sales of badly needed prime stumpage for dependent mills, it has been impossible to take full advantage of such opportunities. Expansion of the timber-sale force would more than pay its way through increased sales of lower-grade materials that will otherwise be wasted through mortality and decay.

The present rate of timber output from the national forests has been attained through a sacrifice in needed work on management plans. Much remains to be done in obtaining adequate inventories and growth estimates that are essential for sound long-range timber management. The management-planning work is at approximately the prewar level when the annual cut was in the neighborhood of 1¼ billion feet. Current cut is more than treble this prewar rate, and management-planning activities need to be increased correspondingly.

Alaska pulp-timber sale.—In August 1948 the Forest Service accepted a bid for 1½ billion cubic feet of timber in the Tongass National Forest in southeast Alaska. The accepted bid was made by the Ketchikan Pulp & Paper Co., an affiliate of the Puget Sound Pulp

& Timber Co., of Bellingham, Wash. The bid contemplates the establishment of a large, modern pulp mill with an ultimate capacity of about 500 tons of pulp per day, at Ward's Cove, near the city of Ketchikan. The Ketchikan pulp-timber unit is the first of five or six such units in the Tongass, development of which is planned by the Forest Service.

This pulp-timber sale is the fruition of 30 years of effort on the part of the Forest Service to bring a pulp and paper industry to Alaska. Providing a stable major industry with year-round operation and employment, the Ketchikan development marks the first step in opening up the territory's huge pulp-timber resources, the largest untapped resources of the kind on the continent. It is expected to play an important role in expanding the economy of Alaska on a sound and secure basis.

The bid was made on the basis of a 50-year cutting contract. After 1962 prices for timber will be subject to reappraisal at 5-year intervals. Outstanding considerations in resource protection stipulated in the contract are the handling of the timber on a sustained-yield basis, the safeguarding of salmon spawning streams which are the basis of the Alaska salmon industry, the preservation of unusually fine scenic areas, and the prevention of stream pollution.

Sustained-yield units.—The Vallecitos Federal sustained-yield unit was established during the year in the Carson National Forest, N. Mex. The area involved—about 73,000 acres of national-forest land—will support a sustained-yield cut of 1,500,000 board feet of timber annually. The purpose of this unit is to provide a larger number of employment opportunities and longer season of employment in the local sawmill. This operation will furnish virtually the only home-town employment for the residents of three small communities. Small ranches and limited livestock production heretofore furnished only a bare subsistence livelihood.

The only other formal action during the year under the Sustained Yield Units Act of 1944 was a public hearing in March 1948 at Quincy, Calif., on a proposed Woodleaf cooperative sustained-yield unit covering certain lands in the Plumas National Forest and adjoining private timberlands. Final action on this proposal has not yet been taken. Detailed information also was prepared on a proposal for a Kootenai sustained-yield unit in northwest Montana. The proposal has attracted widespread local interest, and a public hearing may be scheduled later.

Insect control.—Several severe insect epidemics occurred during the year. The tussock moth outbreak in northern Idaho was completely checked by large-scale airplane spraying operations in 1947. However, the mountain pine bark beetle infestation in southern Idaho and Wyoming lodgepole pine stands continued to spread. An enlarged control project was carried on during the summer of 1948 to stop this epidemic. Most of the infested trees were treated by applications of an insect-killing penetration oil sprayed on the standing tree. This was the first large-scale use of this treating method. It was also used in national forests of the Black Hills area of Wyoming and South Dakota, where a special project was under way to check a serious outbreak of ponderosa pine bark beetle. Cooperative treatment of infested timber in the adjacent South Dakota State Park was included in this project.

Range Management

During 1947 the Forest Service issued 3,248 pay permits for the grazing of 3,403,677 sheep, and 18,494 permits for the grazing of 1,161,905 cattle. With the calves and lambs, for which no fee is charged, and the additional stock grazed under free permit to local settlers, nearly 9,000,000 animals grazed national-forest ranges.

Grazing fees on the national forests are adjusted annually in accordance with the market price of beef and lambs for the preceding year. Under this procedure, cattle fees per head per month increased from an average of 31 cents in 1947 to 40 cents in 1948; and sheep fees increased from 7½ cents to 10 cents.

Hearings.—During the summer and fall of 1947 a subcommittee of the House Committee on Public Lands conducted a series of hearings in the Western States on Forest Service policies and administration of grazing on national-forest ranges. Following the hearings, the committee presented to the Secretary of Agriculture a list of six proposals relating to Forest Service procedure. The Secretary accepted four of these proposals outright. He agreed that all commitments and agreements affecting grazing permits on the national forests should be reduced to writing. He agreed that every doubt should be eliminated as to the right of grazing permittees to be represented by counsel at hearings and to receive a transcript of the proceedings. He agreed that every possible encouragement would be given to permittees to cooperate with one another and with the Forest Service in range improvements consistent with the public interest. And he agreed that consideration would be given to economic conditions affecting the livestock men's operations, the local communities, and tax structures, when reductions in numbers of livestock on the national forests are made. Acceptance of these proposals was in large measure confirmation of policies already long in effect.

A fifth proposal had to do with "impartial appeal boards." The Secretary also agreed to this proposal with the understanding that such boards should act in an advisory capacity only and would not have final authority over grazing and livestock operations on the public forests. He stated that he could not surrender the responsibility for final administrative decisions in the public interest which his oath of office and congressional acts have imposed upon him. In subsequent discussion with the chairman of the subcommittee, it was made clear that the Secretary's and the committee's views were in agreement on this point. A National Forest Board of Review was established in May 1948. (See p. 23.) Local advisory boards representing national-forest grazing permittees have been in operation for many years. Some 800 such local boards are now functioning.

The one proposal the Secretary was unwilling to accept was for a 3-year moratorium on livestock reductions on national-forest ranges. This would have meant postponement of action badly needed to stop serious deterioration of certain watershed and range lands and start them on the road to recovery. In aggregate, the planned reductions in the next 3 years will amount to very little, and will have a negligible effect on the national meat and wool supply. But unfortunately they will hit some individual livestock permittees rather hard, since the heaviest reductions obviously must be made on the most seriously overgrazed and deteriorating ranges.

The report on the 1947 hearings by the House Committee on Public Lands, issued in August 1948, reviewed a number of complaints that had been made against reductions in livestock numbers, and again urged a 3-year moratorium on reductions. The committee, however, recognized the importance of watershed protection, and stated that it was unalterably opposed to overgrazing. It was wholly in accord with the long-established policy of multiple-use management of the national forests, and opposed to sale or transfer of national-forest lands. The committee's report recommended that the Forest Act be amended to include grazing, recreation, and wildlife among the basic uses of national-forest lands, that the present policy of transfer cuts on grazing permits be discontinued, and that advisory boards on the national forests be given legal status.

The report also recommended a vigorous and greatly extended program of range improvements, with encouragement to permittees to participate. It suggested, in effect, that the Forest Service request larger appropriations for this work. This invitation the Forest Service will be very glad to accept.

Range improvements.—To obtain adequate improvements and facilities for efficient use of the forage resource is an outstanding problem on the national-forest ranges today. Over the years a total of about \$16,000,000 has been invested for range improvements on the national forests. This is equivalent to an average of 20 cents an acre for the 80,000,000 acres of national-forest grazing land—an investment which has been wholly inadequate for developing and controlling the use of the resource. Several times this much will be required to develop each of the 10,000 grazing allotments to a point where best use can be made of the forage.

In many instances livestock numbers have had to be curtailed because facilities such as drift fences were inadequate to prevent damage to the range. There are other situations where developments such as water tanks would have made more range available to local stock growers sorely in need of summer forage to balance their ranching units.

Funds for range-development works, other than some recent appropriations for artificial revegetation, have been meager since the days of the Civilian Conservation Corps. Not only has this curtailed progress in getting the ranges in shape for efficient use but many earlier improvements are rapidly approaching a bad state of repair and will need replacement at an early date.

Fences are needed on many national-forest boundary lines in order to exclude unpermitted livestock and to prevent encroachment of permitted livestock on private lands. Division fences are needed in order to assure the utilization of feed over the entire range and to control livestock so that seasonal distribution and other management essentials may be accomplished. Most of the existing Government-built boundary and division fences were erected during the depression years of the '30's and were financed by emergency relief funds. Many of these now have to be rebuilt. Most of them are in heavy snow country and subject to the unusually rigorous weather conditions of the high country. Fences constructed by adjacent landowners also have been used as forest boundary fences, and many of these are likewise old and in need of repair or rebuilding. The landowners feel that because these fences serve as forest-boundary fence as well as to enclose pri-

vately owned land, the Government should assume half of the expense of reconstruction.

Range cannot be utilized without water. Many national-forest range areas are dry, and because of this, forage goes unused on the waterless area while livestock concentrate on and overuse the range where water is accessible. On some areas springs and seeps can be found which, if developed, will provide a source of usable water for livestock. Where there is no surface water, either reservoirs, where there is enough surface drainage to fill them, or wells, if there is sufficient ground water, must be constructed to provide stock water. When such water developments are provided, livestock can spread out, obtain unused grass, and relieve concentration areas. On some ranges more livestock can be grazed.

Of the 80,000,000 acres of grazing land within the national forests, at least 4,000,000 acres are so seriously run down that in order to restore these lands to productivity and prevent further depletion artificial reseeding will be necessary. About one-quarter million acres have been reseeded to date. Congress appropriated \$793,046 for this work for the fiscal year 1949, and legislation was proposed that would continue such work until completed.

The Forest Service has spent much time and effort in developing methods and techniques for reseeding wildland ranges—one of the most difficult tasks in the whole field of agriculture. Although still more research is needed, a sound basis has been developed on which to proceed in the revegetation of many types of depleted grazing land.

Watershed Management and Flood Control

Progress is being made in various forest regions in getting local recognition of watershed-management problems and in improving some sore spots.

At the request of the city of Grand Junction, Colo., a detailed analysis of watershed conditions was made on the Kannah Creek watershed of the Grand Mesa National Forest, which is the source of water for the municipality. The study showed that portions of the watershed have deteriorated considerably because of impairment of the plant cover and subsequent soil erosion. Adjustments in use on the watershed, especially grazing use, were clearly indicated.

In Arizona and New Mexico, field examinations were completed on two municipal watersheds, and an investigation was made of damages to surrounding lower areas from land practices on portions of one watershed. Watershed reports were made covering six different forest divisions in the region, primarily for the purpose of developing comparative watershed values in relation to future land-management activities in the counties involved.

In the Intermountain States, conditions on several municipal watersheds have been reviewed in studies in which water users, city and county officials, stockmen, and other interested groups cooperated. In some cases, local watershed committees were organized. Programs pointed toward rehabilitation of damaged water-source areas are now under way on sore spots in the Manti, Fishlake, Dixie, Boise, Bridger, and Toiyabe National Forests.

In California, particular attention is being given to the need for

preservation of natural stream values in relation to the effects which may be produced on them by large impoundments and diversions of water for important industrial uses in the valleys.

Recognition of watershed problems in the East is indicated by the preliminary watershed-management plans recently completed for the White Mountain National Forest in New Hampshire and Pisgah National Forest in North Carolina.

Flood-control projects.—Steady progress was made during the year in watershed rehabilitation work on four flood-control projects authorized by the 1944 Flood Control Act. Responsibility for these projects has been assigned to the Forest Service. On the Los Angeles River watershed, fire-control installations, channel developments, and some roadbank stabilization work were emphasized. The channel developments include several types of construction, such as concrete dams and cribs and metal bins. Planting for flood control and roadbank erosion control were given priority on the Little Tallahatchie and Yazoo River Basins in Mississippi. In the Potomac River watershed, cooperative timberland improvement is getting under way.

Recreation

With a total of 21,000,000 visits reported, not including motorist-sightseers and transients, recreational use of the national forests in 1947 was up 17 percent from 1946. Winter-sports visits during the calendar year increased 38 percent over 1946.

A memorandum of understanding between the Bureau of Reclamation and the Forest Service has been signed relating to the management of national-forest lands within reclamation withdrawals. An agreement was made with the National Park Service concerning special treatment for the Grandfather Mountain-Linville Gorge area of the Pisgah National Forest.

The large recreation load at Shasta Reservoir in northern California became the responsibility of the Forest Service on July 1, 1948, as the result of legislation enacted by Congress adding lands surrounding the reservoir to the Shasta National Forest. The area involved is heavily used for recreation purposes.

Interest in resort sites and ski-lift permits has heightened. Large new developments are under way or imminent at McCall, Idaho, Berthoud Pass and Arapaho Basin in Colorado, Stevens Pass in Washington, Shasta Reservoir and Big Pines in California, Snow Basin in Utah, and elsewhere.

Avalanche control.—A small beginning has been made at Alta, Utah, on meeting the problem of avalanche control. Most good winter-sports areas are located in areas of some avalanche hazard. It is known that some avalanche areas can be kept under control by continuous skiing; some avalanches can be predicted by experienced men; and avalanches can sometimes be precipitated under control by explosives during a nondanger period. By controlling avalanches or by closing areas to use during hazardous periods, the chances of loss of life may be greatly reduced. The Forest Service recognizes its obligation in this respect and hopes to carry on further studies to determine the best methods of predicting and controlling avalanches so as to reduce the hazard to a minimum.

Wilderness areas.—Wilderness preservation was furthered by the approval of roadless areas in the Superior National Forest, Minn., by the Secretary of Agriculture. The new classification for the Superior Roadless Areas recognizes a no-cutting area around the recreationally important wilderness lakes along the Canadian border. The Gates of the Mountains Wild Area was established by the Forest Service in the Helena National Forest, Mont.

Special-use fees.—The Forest Service embarked on a new method of calculating permit fees for public-service resorts in the national forests. The new charges are based on net sales, and will vary with the type of business and the volume of business. The objective is still the same—to obtain an equitable return to the United States from the use of national-forest land for commercial purposes.

Pikes Peak Highway.—An exception to established national-forest policy was authorized by the Secretary of Agriculture in the issuance of a permit to the city of Colorado Springs to operate the Pikes Peak Highway as a toll road. The exception to the no-toll-roads policy was based on the fact that neither the State of Colorado nor the Forest Service had funds available to maintain this road, and road-maintenance work was necessary to accommodate the heavy tourist use.

Dams.—Among the many recreational facilities constructed in the national forests during the Civilian Conservation Corps program were a number of dams creating artificial lakes and swimming spots. The dams received little attention during the war years and a backlog of maintenance work has built up. Eleven of these dams are now in such condition that the unwatering of the reservoirs may be necessary as a safety precaution unless repairs can be made in the near future. Draining of these popular lakes and reservoirs would seriously impair the recreation values of the surrounding areas. The Forest Service hopes that funds will soon become available for the repair of these dams, and also for the completion of five others which were started by the CCC but were not finished because of the war.

Wildlife

The Forest Service had expected to step up its wildlife development and improvement work in the national forests to the prewar level. Congress, however, did not appropriate the \$162,813 requested for this work for the fiscal year 1948. In commenting on this elimination of specific funds for wildlife management, the House Subcommittee on Agricultural Appropriations said: "It is not the purpose of the committee to eliminate the functions relating to wildlife resources. It believes, however, that the function can be cared for out of other general items."

Elimination of the funds did not eliminate the problems. A special effort was made to maintain a skeleton organization of at least one man in each of the regional offices, except Alaska, to keep abreast of the major difficulties and to maintain the cooperative enterprises that are carried on with the various State fish and game or conservation departments.

Cooperative activities.—The Forest Service was able to continue its cooperative wildlife programs with most of the States in which national forests are located. The program in Virginia, in which the

State sells a special stamp to all of those hunting or fishing in designated national-forest wildlife management areas, is continuing to be a trail blazer in productive cooperative wildlife management. The program was more popular than ever. Four times as many stamps were sold during the past year as were sold when the project was first initiated. Satisfactory progress can be reported also for other cooperative wildlife management and demonstration areas located in the Eastern and Southern States.

Following the pattern developed in the East, the Forest Service and the State of Arizona have entered into an agreement for joint administration of the famous Grand Canyon National Game Preserve in the Kaibab National Forest as a cooperative wildlife management area.

In Montana and northern Idaho, the Forest Service and State agencies cooperated in conducting field-condition surveys on the national forests. This work is giving a much clearer picture of actual wildlife assets and problems than has ever been obtained before. The Forest Service also cooperated with these States and with Oregon and Washington in carrying out programs to provide salt for big game. In Montana, the State and the Forest Service prepared 5-year fish-stocking plans for the national forests.

In New Mexico, the State and Forest Service made final arrangements for the establishment of a herd of elk in the Jemez Mountains. In southern Idaho, western Wyoming, Utah, and Nevada a total of 95 special hunts on areas of big-game overpopulation were conducted cooperatively with the States involved. Satisfactory hunting programs have now been developed for practically all national-forest lands in these States.

A program has been worked out with State agencies of Oregon and California for management of the interstate deer herd which ranges on national forests and other lands on both sides of the California-Oregon State line.

The Forest Service was able to continue cooperating with the States in the trapping and transplanting of deer in North Carolina and Arkansas. Successful big-game hunts were carried out in these States and in Tennessee, Georgia, Alabama, and Florida.

Some of the Central States, such as Missouri and Indiana, were able to report very sizable increases in the number of deer on the national forests. In Illinois the Forest Service created additional small fish ponds by requiring that holders of special-use permits for borrow pits leave their operation in such a condition as to hold a permanent supply of water. Forest-management practices, both harvesting and reforestation, in Michigan national forests were re-oriented, with the requirements of a productive wildlife habitat given increased consideration.

Forest-Fire Control

At no time of the year are all parts of the country free from danger of forest fires. Even in a year most favorable from the standpoint of total losses, fires may occur that are disastrous to some local communities.

In such relative terms, the number of forest fires and the losses suffered in the national forests during the early part of 1948 were low.

There were serious fires in California later in the season, but the full record for 1948 and its significance will have to await later appraisal. Consequently, the conditions and experiences of 1947 will serve best in a review of recent work and accomplishments.

1947 season.—Some regions experienced relatively easy fire weather conditions in 1947, but others had some of the most dangerous weather in years. One of the worst drought periods in decades developed in Arizona and New Mexico. Similar prolonged dry periods were experienced in Nevada and southern Idaho. Extraordinarily dry periods of shorter duration occurred in the New England States, and in Texas, Louisiana, Illinois, Missouri, Arkansas, Wisconsin, and Michigan. Although the severe fires in the States of Maine and Texas did not do appreciable damage to national-forest lands, they did great damage to State and private lands and property, and illustrate the severity of the fall fire season in those areas.

The 1947 fire season in California rated among the four driest on record. The low winter snow pack and the dry spring, summer, and fall periods had their impact on fire-suppression activities, particularly in the national forests south of Redding. For successful control small fires had to be attacked fast and hard, and large fires proved very difficult to handle, requiring full emergency mobilization of all available equipment and manpower from large areas.

During 1947 a total of 11,225 forest fires in the national forests were controlled by the Forest Service. Of this total 6,815 were reported to be man-caused and 4,410 caused by lightning. All told, there were fewer lightning fires than usual during 1947. But in Montana and northern Idaho 1,321 lightning fires occurred in a 52-day period, resulting in a serious strain on all fire-fighting facilities, which offered otherwise favorable conditions in this region.

Fires in 1947 burned 187,006 acres of national-forest lands and 67,407 acres of privately owned lands inside national-forest boundaries. In terms of acres burned the 1947 record was not unusual, but costs and damages were the highest experienced since the prewar period.

Labor for fire fighting continued to be a serious problem. Where fire emergencies developed and it became necessary to recruit labor from industrial or other centers, quality and performance were unusually low. Fieldmen report performance at 60 percent or less of what it was 15 years ago. This low output, at current fire-fighting wage rates, increased the difficulty of attaining efficient operation and greatly increased the cost.

Excellent cooperative relationships with other Federal, State, county, and private agencies in matters of fire prevention and suppression continued to be the rule in 1947. Forest permittees, particularly the stockmen and timber operators, did everything in their power to assist the Forest Service in the suppression of fires. The armed services and the States, counties, and municipalities came through with aid in a number of instances when the going got "tough."

Increased use of equipment.—Use of specialized equipment in the control of fires is increasing each year. Mechanized trail builders and tank trucks again demonstrated their value as suppression vehicles. Airplanes were used extensively. In the California region a total of 86 different planes of varied ownership participated in fire-suppression work during the year. Helicopters were used successfully on a large fire-suppression job for the first time this year in California.

Results indicate this machine may solve many problems of fire fighting in rugged terrain and inaccessible country.

Radios, power felling saws, and many other pieces of fire equipment also contributed increasingly to the efficiency of fire suppression work.

Smoke jumpers.—The delivery of trained fire fighters to forest fires in back-country areas by airplane and parachute has continued to demonstrate its value. For the most part "smoke jumper" operations in 1947 were confined to national-forest areas in Montana, Idaho, Washington, and Oregon, with small-scale operations in northern California; but a new operation was started on a trial basis in New Mexico. Initial attack was made on about 200 fires by parachute fire fighters. Air-borne fire fighters prevented many potentially bad fires from becoming large. In northwestern Montana a total of 75 smoke jumpers jumped to a single fire and were responsible for the control of a serious back-country fire at a relatively low acreage. This mass attack from the air was an innovation. Usually, when a fire got too big for a few smoke jumpers to handle, ground crews were brought in as reinforcements. Sometimes delay in getting reinforcements by usual means has resulted in serious losses. When available, quick reinforcement by air may therefore be invaluable.

Fatalities.—Four lives were lost fighting forest fires in 1947. Two men died of injuries suffered while engaged in fire fighting, and two men were burned to death on a fire on the Angeles National Forest in California.

Flood damage.—The 1948 floods in the Columbia River Basin caused damage estimated at some \$6,000,000 to national-forest property and improvements. An additional \$4,800,000 damage to intermingled and adjacent private property was reported. On the national forests alone, 500 bridges were wrecked or impaired, 4,300 miles of roads were cut by wash-outs, and 980 miles of communication lines were disrupted. This heavy damage had Forest Service fire-control men in the Pacific Northwest greatly worried as they entered the 1948 fire season. Until disrupted transportation and communication facilities could be repaired, fire-control operations would be seriously handicapped. Congress made a special appropriation to meet the emergency.

Improvements and Facilities

Forest-development roads and trails.—During the fiscal year 1948, expenditures on the national-forest road and trail system approximated \$19,000,000. The appropriation for this work was \$11,000,000; the balance consisted of \$1,800,000 of 10-percent road funds and about \$6,200,000 of funds transferred to the Forest Service by the National Housing Agency for the construction of roads to stands of Government timber.

Including the Housing Agency funds, about \$11,500,000 was used for improvement and construction of timber-access roads. This completed about 1,100 miles.

Maintenance work to preserve the investment in the transportation system and to provide for reasonable service to traffic essential for protection, administration, and utilization of the national forests was accomplished on about 76,000 miles of roads and 100,000 miles of trails at a total cost of approximately \$7,500,000. Nearly \$1,500,000 of this

was used for replacement of bridges. Bridge repair or replacement is currently representing an unduly large portion of the annual maintenance work due to the many short-life timber structures built during the Civilian Conservation Corps program under restrictions then in force limiting purchase of materials.

Water resources.—During the past year the Engineering Division of the Forest Service, in cooperation with the Federal Power Commission, administered power projects on the national forests whose output was valued at more than \$25,000,000. There has been unusual activity in power and other water-use developments since the end of the war and indications are that this will continue.

In addition to power dams, six irrigation-water supply dams were approved for construction on the national forests.

Aerial photography and mapping.—Approximately 3,640 square miles of planimetric mapping were completed in the northern, Pacific Northwest, and California regions. Approximately 15,929 square miles of aerial photography were placed under contract in western regions.

National-Forest Properties

On June 30, 1948, the 152 national forests, 43 purchase units, 17 experimental forests or ranges, and 11 land-utilization projects administered by the Forest Service included a gross area of 228,936,105 acres and a net area of Federal land subject to Forest Service management of 179,764,502 acres. This net area was 449,746 acres greater than on the same date in 1947.

The Montezuma National Forest in Colorado was abolished and the lands therein made parts of the Uncompahgre and San Juan National Forests in the same State. This action was taken in the interest of administrative efficiency and economy, after a determination that the lands could be administered as parts of the other two national forests without detriment to the resources or undue loss of public service. A gross area of 2,400 acres, of which 920 acres were owned by the United States, was added to the Fishlake National Forest in Utah by public land order.

Land purchases.—For fiscal year 1948, Congress appropriated \$750,000 for purchase of lands under the Weeks law of March 1, 1911, a decrease of over 70 percent from the appropriation for fiscal year 1947. A net of \$136,686 was also appropriated under the several "receipts acts" to meet the acquisition problem on certain national forests not subject to the Weeks law. Pursuant to such appropriations, a total of 431 tracts comprising 96,250 acres were approved for purchase under the Weeks law, and 13 tracts involving 7,240 acres under the receipts acts. These purchases were situated in 41 national forests or purchase units in 25 States and Puerto Rico. With the exception of the Arrowrock unit in Idaho, in which 6,154 acres were approved for purchase, the purchases under the Weeks law were in units east of the Great Plains. Purchases approved under the receipts acts were in national forests in Utah and California. While the appropriations were too small to make any substantial progress on the large land-acquisition job necessary to consolidate and build up the national-forest properties to maximum effectiveness, they were, never-

theless, of substantial assistance in the purchase of key properties and in consolidating some of the purchase areas.

Exchanges.—In addition to purchases of land, 152 applications to exchange privately owned land for national-forest land or timber were received and acted upon. During the year title was accepted to approximately 331,000 acres of land which had been offered to the Government in exchange. For the land so accepted approximately 48,000 acres of national-forest land and 308,000,000 board feet of national-forest timber were or will be granted.

Boundary extensions.—During the fiscal year the Congress passed and the President approved several acts extending the boundaries of the national forests. Public Law 339 extended the boundaries of the Modoc National Forest in California to include about 37,433 acres, mostly privately owned timberland. Public Law 449, effective July 1, 1948, added 108,000 acres, more or less, of public lands surrounding Shasta Lake of the Central Valley project in California to the adjacent Shasta National Forest, and extended the exchange act of March 20, 1922, to the intermingled non-Federal lands. The purpose was to assure protection and administration of the watersheds tributary to the reservoir, management and restoration of timber, and administration of the recreational resources of the lake and surrounding land. Public Law 650 added a gross of 70,733 acres to the Caribou National Forest in Idaho for the purpose of promoting watershed conservation and integrated use of the land with adjoining national-forest areas. Public Law 719 added to the Nicolet National Forest in Wisconsin, upon concurrence of the directors of the Wisconsin Rural Rehabilitation Corporation, 680 acres of timberland acquired for the United States by that corporation and recently assigned to the Lakes States Forest Experiment Station as a research area. The actions of Congress in thus extending the national forests are most helpful in accomplishing the broad programs of watershed and timber conservation.

Of considerable importance also is Public Law 733, which authorizes exchanges of lands in the Shipstead-Nolan Law area (46 Stat. 1020) within the Superior National Forest in Minnesota, and the appropriation of \$500,000 to purchase privately owned lands within a specified portion of that area. The chief purpose of such purchases is to preserve the natural character of the wilderness lake area, which is fast being destroyed by numerous commercial resort and cabin developments on private lands within the wilderness area.

COOPERATION IN STATE AND PRIVATE FORESTRY

Forest-Management Assistance to Woodland Owners

Of the 345,000,000 acres of commercial forest land in private ownership in the United States, 75 percent is in small holdings, averaging about 62 acres each. These small holdings include some of the best land for providing continuous crops of commercially valuable and readily accessible timber. Generally, they are overcut and understocked. As old-growth forests disappear, second growth from the small woodlands must be the source of a large share of the forest-products supply of the future. The small woodlands must be made and kept productive.

To aid woodland owners in applying good management to their timber holdings, 173 farm-woodland-management projects were in operation during fiscal year 1948. They are conducted in cooperation with 40 States under terms of the Cooperative Farm Forestry (Norris-Doxey) Act of 1937. The Forest Service and the States share the costs of these projects, in each of which a forester is made available to advise and assist woodland owners on timber-management and marketing problems. On July 1, 1948, all projects were placed under State direction on a Federal reimbursement plan of financing similar to the cooperative fire-protection and tree-distribution programs.

In fiscal year 1948, 14,220 individual small owners were helped to apply improved management practices on 1,399,971 acres of woodland. Under advice of the project foresters 503,641,000 board feet of sawlogs and other products were harvested. The woodland owners received \$7,668,499. Included in this forest harvest were 4,803 barrels of gum for naval stores and 66,670 gallons of maple sirup. The project foresters assisted some 5,500 small sawmill owners and other small forest-products operators in forest-marketing problems relative to products from small woodlands. There were 2,558 unfilled requests for service from individual woodland owners at the end of the year.

Of the 2,000 counties in the United States that contain sizable amounts of farm woodland, some 750 now have technically trained project foresters available. Many more "Norris-Doxey foresters" will be needed if all counties with small privately owned woodlands are to be served.

Technical foresters working out of the regional offices of the Forest Service or cooperating in State foresters' offices continued to furnish assistance to individual owners of numerous large and medium-sized holdings. Constant progress is being made even though such expert technical assistance always has been limited. Many large owners and some with medium-sized woodlands have employed trained foresters or engaged private consulting foresters to advise and assist them in the wise management of their forests. Here the technicians of the Forest Service work with the foresters concerned on technical procedures and standards rather than actually assisting on the job in the woods.

Farm-Forestry Extension

The Forest Service works closely with the Department of Agriculture's Extension Service in conducting educational programs through the State agricultural extension services of the land grant colleges designed to build up interest and stimulate action in growing timber as a crop on the farm. The Federal Extension Service employs two extension foresters who serve in a liaison capacity with the Forest Service, coordinate the programs between States, and serve as channels for distributing forestry information prepared by the Forest Service to the State extension foresters and through them to county agricultural agents and farmers.

The 45 States and 2 Territories cooperating with the Department in farm-forestry extension employ 65 extension foresters. Through the State extension organizations and county agricultural agents, the extension foresters work to encourage woodland owners in recognizing forestry problems and in applying improved woodland-management

practices. Various educational means are used, such as demonstrations, meetings, leaflets, radio, and the press. Extension cooperation also is given to State forestry departments in the distribution of tree planting stock, demonstrations on how to plant trees, and in the stimulation of interest in the control of woods fires. By developing forestry projects for farm youth much interest has been aroused in better care and management of farm woodlands, in wildlife conservation, and in farmstead protection.

The State-wide programs of the extension foresters have helped to pave the way for the direct on-the-ground service to individual woodland owners provided by the Norris-Doxey farm woodland management projects previously mentioned.

Cooperative Tree Distribution to Farmers

In fiscal year 1948 there was a continued and widespread interest in farm tree planting. Forty-two States and two Territories cooperated with the Forest Service in the production and distribution of forest-tree planting stock under terms of the Clarke-McNary and Norris-Doxey Acts. State expenditures exceeded by six times the Federal appropriation of \$124,600 available for this work. Many of the States were still unable to fill all orders for planting stock.

More than 42,000,000 seedlings and transplants were distributed at cost or less to farmers for planting for windbreaks and shelterbelts, for timber production, or for erosion control. This was considerably less than the number expected to be available for distribution because there were problems of seed shortages, labor inadequacy, failures in nursery production due to floods and drought, and delays in expansion of nursery facilities. There are now 73 State tree nurseries and 10 in the 2 Territories operating under the cooperative program. Total capacity is estimated at 388,000,000 seedlings for the States and 14,000,000 for the Territories, or a total potential capacity of 402,000,000 seedlings a year.

Production of planting stock for 1949 is estimated at about 200,000,000 seedlings. Some States will arrive at full production; others will be several years reaching capacity. Deficiencies in equipment and funds are now the chief factors limiting production. Demands will be far in excess of the available trees, and a practical program of 1,000,000,000 seedlings per year is a desirable goal. Even at this rate it would take about 40 years to accomplish the job of planting the estimated 44,000,000 acres of farm lands that should be in trees.

Naval Stores Conservation Program

The year 1948 was the thirteenth consecutive year in which a Naval Stores Conservation Program has been in effect. This is a part of the general Agricultural Conservation Program set up under the Soil Conservation and Domestic Allotment Act. Its administration has been delegated to the Forest Service by the Production and Marketing Administration.

The beneficial effect of this program extends to the entire forest resource of the naval stores region, comprising about 50,000,000 acres of productive forest land. Turpentine farming represents the great-

est single use of land in the deep South, and the greater part of this extensive forest area is directly controlled through ownership or lease by gum naval stores producers.

The program provides small benefit payments to turpentine operators who meet certain requirements of performance. Its objective is to encourage sound conservation practices in naval stores operations. In the earlier years the performance requirements were directed mainly to prohibiting the turpentineing of undersized trees, with the result that this once widespread uneconomic practice has now been almost entirely eliminated. In later programs performance requirements have been enlarged to promote better cutting practices, improved fire protection, selective-cupping practices to improve growing conditions in timber stands, and the promotion of the use of chemical stimulants to prolong gum flow from turpentine faces. The 1948 appropriation for this program was greatly reduced, but the continuing interest and participation by producers has been maintained.

Cooperative Fire Control on State and Private Forest Lands

Federal cooperative assistance in the prevention and suppression of forest fires on State and privately owned forest lands is continuing, under authorization of the Clarke-McNary Act, in 43 States and Hawaii. During calendar year 1947 organized protection against fire was provided for 328,000,000 acres, an increase of 9,000,000 acres over 1946. Gradually, control of wild fires is being extended and intensified. But there still remain 111,000,000 acres of privately owned forest lands needing protection but as yet receiving no organized fire control whatever. The present degree of protection in many other areas is below what is considered essential for good forest management.

Congress raised the Federal appropriation for cooperative fire protection from \$8,300,000 in fiscal year 1947 to \$9,000,000 for fiscal year 1948. This is the ceiling of the present authorization. Cooperating States spent \$13,317,000 of State and private money in the cooperative protection program during calendar year 1947, an increase of 24 percent over similar expenditures during the previous year.

At approximately 5-year intervals the State foresters and the Forest Service jointly work up a detailed estimate of the non-Federal areas in need of fire control in each State and the cost of establishing a basic level of necessary protection. In 1938 this survey indicated that an annual expenditure of \$18,000,000 would be required to handle the job in all important forested States. On the assumption that the Federal Government would share half the cost, this 1938 estimate was the basis for the present Clarke-McNary authorization of \$9,000,000. The latest comprehensive survey, made in 1945, showed that the protection job on the 439,000,000 acres of non-Federal forest and important watershed lands needing organized fire control would cost approximately \$32,000,000 per year. It is now estimated that protection of these areas would cost about \$40,000,000 a year, of which the Federal Government's share would be \$20,000,000. The substantial increase in estimated cost since the 1938 and 1945 calculations is largely due to further increases in wages, salaries, cost of equipment, and other items needed in the protection effort. The increase is also partly due to a

more comprehensive and careful determination of protection needs and the inclusion of over 16,000,000 acres of important nonforested watershed areas not embraced by the 1938 estimate.

In 1947 (latest year for which complete reports are available) fires burned 2,814,381 acres, or less than 1 percent of the protected area of State and private forest land. This exceeded by 561,586 acres the area burned during 1946—a more favorable year. Number of fires on protected lands increased from 66,103 in 1946 to 71,442 in 1947. Southeastern Texas, Louisiana, and southern Maine suffered unusually high fire occurrence and acreage burned. But although 9 percent more fires occurred on the protected area in 1947 as compared with the previous 5-year average, they burned 132,300 fewer acres.

Dependable figures are not available for the 111,000,000 acres of unprotected forest lands, but the best estimates of State men most familiar with the situation indicate that about 18 percent of the unprotected areas burned over in 1947, or more than 20 times the relative burn on areas which received organized fire control.

Damage estimates for both protected and unprotected forest lands are known to be unduly conservative because they often fail to include full tangible losses and completely ignore the many intangible and indirect damages resulting from forest fires, such as those caused by decay of fire-damaged timber, replacement of desirable tree species by less desirable ones, soil deterioration and erosion, uncertain stream flow, destruction of game habitat, interruption of tourist use, and the like. However, the damage figures reported for 1947 were \$21,378,477 on the protected area and \$30,856,385 on the unprotected, or a total of \$52,234,862, as compared to \$31,347,216 in 1946. The disastrous Maine fires accounted for a large part of this increase.

Cooperating States have made substantial progress in expanding protection to unprotected private forests since World War II. Twenty-five million acres have been added to the protected area. Extending protection to the 111,000,000 of unprotected lands as rapidly as possible is the high-priority unfinished job in this Federal-State co-operative program.

Community Forests

The past year registered a phenomenal increase both in number and in area of county, municipal, school, and other community forests. The number of community forests now reported is 3,113 and the area has increased to 4,413,950 acres. This is an increase of 25 percent in number and 28 percent in area in a single year.

The Forest Service is cooperating with State forestry agencies in encouraging the establishment and development of community forests. The additions of the past year were mainly in the lists of county and public school forests. Large additions to the areas in county forests were made in Minnesota, Oregon, and Wisconsin. A number of these have been dedicated as living war memorials to the men and women of the armed forces. Marked increases in the numbers of school forests occurred in Florida and Michigan. Michigan now leads all of the States in the number of community forests, having reported 846, of which 627 are school forests. Many of these are used as outdoor laboratories in connection with the school work.

FOREST RESEARCH

Although no additional research centers were established by the Forest Service during the year, work at those already in operation was alertly carried forward. Some of the newer research centers are in areas where there are no national forests. In the establishment of experimental forests within such research-center territories, the interest of industrial and State and private institutions has been very gratifying. Cooperative agreements for the use of State lands were made in Minnesota and Iowa; for the use of industrial holdings in Pennsylvania, Virginia, Washington, Alabama, and Georgia; and for the use of lands belonging to a college in New York. Not only does the cooperative use of the land make it possible to carry on experimental work, but the forests will serve as demonstrations and will help to interest other landholders in sustained-yield management on their properties.

At several of the regional forest experiment stations, cooperative studies have been undertaken that pool the interest and information of a large number of industrialists, State forestry officials, forestry-school personnel, and the Forest Service. Among these is the study of control of spruce budworm in New England. Here large paper companies and others have made their lands available for the establishment of experiments in silvicultural methods aimed at reducing budworm damage.

A council representing all interested parties has been formed to advise the Forest Service's Northeastern Forest Experiment Station and to help get into practice the measures indicated by its research.

In the Pacific Northwest, where second-growth Douglas-fir is coming into first importance, a "town hall meeting" of Douglas-fir foresters was held in March 1948. As a result of this meeting the Pacific Northwest Forest and Range Experiment Station organized a nine-man committee representing the forestry schools, industries, and State and Federal Forest Services to promote experimental work in the management of second-growth Douglas-fir. The committee has prepared a report bringing together all available information on the subject, which is already in wide use and great demand. The report will form the basis on which additional research work will be undertaken, and will be revised from time to time as new experience becomes available.

Forest Management

Harvesting and reproducing the forest.—Information and experience on a number of important forest types was rounded out and fitted together during the year. Notable among them was the ponderosa pine type, in which all of the western forest experiment stations are concerned.

The California station has now completed initial cuttings in virgin ponderosa pine stands over most of the Black's Mountain Experimental Forest. These initial cuts aimed to remove, first of all, the trees most likely to be susceptible to bark beetle attack. They have reduced the mortality during the 6 years since the cutting began to less than one-fifth of that in the virgin forest. The light partial cuttings also have increased the rate of growth beyond the expected

capacity of regulated stands in some cases. At the Pacific Northwest Station emphasis has been placed on vigor classification in the selection of ponderosa pine trees to be cut. Here again the use of light cuts is proving satisfactory. The value of such cuts was further proved at the Northern Rocky Mountain Station, where examinations of 35-year old cuttings showed that the lightest cuttings were followed by the greatest increase in growth. However, there is evidence of a slowing down of growth rate in these old cuttings, indicating that the stands should be worked over again to remove the slower growing individuals. In general there seems to be evolving a system for the handling of the widespread ponderosa pine type, which involves, wherever it grows, light, frequent cuttings.

During the year, the Forest Service published a circular on the management of red pine in Minnesota, presenting the results of studies by the Lake States Forest Experiment Station on this species. Red pine, which formed an important component of the famous virgin pine forests of Minnesota and the other Lake States, is of rapid growth and comparatively free from insect pests and diseases. It produces high-grade lumber, and the natural second-growth stands have been augmented by large areas of forest plantations. The Lake States Station's and cooperators' studies indicate that intensive management of red pine stands requires frequent thinnings and light improvement cuttings, followed at the end of the rotation by reproducing the stand by the "shelterwood" method—that is, removal of the mature timber in a series of cuttings so that natural reproduction may become established under the partial shelter of seed trees. Natural reproduction may be increased if the ground is scarified prior to the seed fall. It was found that the older method of seed-tree cutting (leaving only a few seed trees per acre) often resulted in good forest land being taken over by brush.

Research is showing that in many instances sound forest management is the best means to minimize damage to timber stands from insects and diseases, and to decrease control costs. The Northeastern Forest Experiment Station's work with the spruce budworm has been directed toward improving methods of cutting in northern coniferous stands. Overmature and decadent balsam fir is especially attractive to this insect, and prompt removal of these trees not only tends to immunize the stand from severe attack but renews the vigor of the younger, better trees in the forest. In the southeastern region, it is becoming more apparent that the baffling "little leaf" disease of short-leaf pine is somehow related to the nutrition of the trees. If this is so, it is quite possible that silvicultural practices aimed at improving soil conditions may be a means of alleviating the trouble.

Improvement cuttings.—There has been much interest in the use of chemicals to control unwanted forest "weed" trees. A number of chemicals which became available during the war are being tested at the Southeastern Station and elsewhere. The effectiveness of chemicals varies with the season, size of trees, and species. Costs seem to compare favorably with other less satisfactory methods of controlling unwanted vegetation. However, the long-time effect of the changes caused by the use of chemicals is not known, and their widespread use cannot yet be recommended.

Studies at the Southern Station indicate that removing low-grade hardwoods in pine-hardwood stands is one of the most effective fores-

try measures a landowner can take. Even in areas where hardwoods are unsalable, the increased growth of the pine soon pays for the cost of the treatment. Experiments showed that heavily treated stands produced 17 times as much volume of pine in the first 7 years after treatment as did lightly treated stands.

Planting.—Research is adding new findings and new experience to the solution of such problems in tree planting as the choice of species for various sites, the spacing of trees, season for planting, site preparation, and the best kind of nursery stock to use. Machines have been adapted to the planting of many of the sites in need of reforestation, and the labor requirements of forest nurseries are being reduced by the use of mechanical cultivators, transplanters, and stock lifters, and by chemical weeding.

During the year, the Forest Service issued a Farmers' Bulletin on tree planting in the Central, Piedmont, and Southern Appalachian regions, which summarized findings from a number of years of study at the Southeastern and Central States stations. A similar bulletin is being prepared for the New England and Lake States regions and another for the Southern States.

Although the airplane is already used extensively for seeding agricultural crops, the method is of limited usefulness in reforestation work because site preparation and control of rodents is quite essential to any successful direct seeding operation. However, immediately after a severe forest fire, conditions may be such that seeding from the air can be accomplished successfully. Rodents will have been killed or driven from the area and competing vegetation destroyed. The severe fires that occurred in Maine in 1947 presented both need for reforestation and opportunity for experimental work. The Northeastern Station made the best of this chance by undertaking an airplane seeding experiment on the Massabesic Experimental Forest near Alfred, Maine, in February 1948. Seeds were sown from the air in densities ranging from 4,000 seeds per acre up to 60,000. At a density of 8,000 seeds, the cost per acre ran about \$3. With present high cost of planting stock and prevailing wage rates, planting white pine trees by hand would have cost at least \$35 per acre. Comparisons of cost mean nothing, of course, until the success of the seeding is known. Already, however, there are indications that a good crop of young trees will result. But good luck may have been a big factor in the success of the operation. The seeds fell on a blanket of soft snow which prevented them from drifting, and another fall of snow that came soon after hid the seeds from birds and animals that might have eaten them.

Protection.—Forest research turned to some of the fundamentals of physics and human physiology in a study of some principles of visibility and their application to forest-fire detection. A report published during the year brought out important findings about the human eye as an optical instrument, about atmospheric haze, and about their effects on the ability of lookout men to see and recognize smokes from forest fires. Among the practical developments reported were various visibility meters which make it possible to measure the amount of haze in the atmosphere and then to calculate the distance that smokes can be seen. Based on the fact that haze polarizes light, an instrument was developed with which smokes invisible to the unaided eye can be seen. A simple, reliable eye test for lookout men was devised. The report also covered the characteristics of

binoculars, telescopes, haze filters, and goggles and their usefulness for lookouts, and the best designs for lookout houses to make fire detection as easy and sure as possible. In an appendix the mathematical theory on which these developments are based is given in enough detail so that physicists may make use of it to further advance this kind of research.

Genetics.—Recent work at the Institute of Forest Genetics at Placer-ville, Calif., a branch of the California Forest and Range Experiment Station, has been marked by the mass production of hybrid pine seeds and the development of nursery stock of these hybrids for large-scale testing under forest conditions. Among the hybrids now ready for testing are various crosses between ponderosa pine and its near relatives, Jeffrey and Coulter pine; crosses between jack pine and lodge-pole; and between eastern and western white pines. Several of the hybrids being tested show hybrid vigor—that is, they grow faster than either of their parents. Others combine rapid growth of one parent with hardiness of the other. They can be grown beyond the natural range of the fast-growing parent. The regional experiment stations are establishing plantations to test these hybrids.

Forest Influences

Columbia River flood.—A crew of Forest Service watershed specialists was dispatched to the Pacific Northwest in May 1948, before the flood in the Columbia River Basin had subsided, to make a survey of flood damage to national-forest property and to study the relation of watershed conditions to the flood runoff.

Immediate causes of the flood that inundated Vanport, Oreg., parts of Portland, and other cities, towns, industrial developments, and farms, took more than 40 lives, made 60,000 persons homeless, and caused some \$200,000,000 of property damage, were the extraordinary weather conditions prevailing over most of the basin. Abnormal accumulations of snow, a late spring, then prolonged rains and a sudden unseasonable hot spell that quickly melted most of the snow sent high water streaming down from snow-covered highlands in all parts of the basin. However, the watershed technicians found ample evidence that damage in the upland valley areas would have been far less severe and that considerable water would have been held back until after the flood peaks had passed, if millions of upland acres had not previously been depleted of their plant and forest cover, mainly by forest fires.

Striking evidence that forests slow the rate of snow melt and thus delay high water flows such as contributed to the floods was observed by the investigators. As late as June 14, about 15 days after the flood peak, timbered areas in the uplands were seen to be still blanketed with snow, while nearby burned-over sections were snowless. This was particularly apparent at higher elevations. In many instances, burned and denuded north and east slopes, that normally should hold their snow longest, had lost all their snow, while timbered south and west slopes were still snowbound.

Rough ground measurements on a number of small drainages showed peak discharges from severely burned or otherwise disturbed drainages averaging 50 percent higher and in some cases nearly 100

percent higher than those from unburned ones of similar elevation and topography. Runoff from burned, logged, or overgrazed drainages also carried more debris, caused more channel and bank cutting, more sedimentation in lower streams, and damage to roads and bridges.

Forest fire has been the most important factor in denuding millions of watershed acres in the Columbia Basin. Logging, grazing, farming, mine or smelter operations, and road building, where done without apparent consideration for watershed values, were other causes. The report of the investigating group pointed out that flood damage traceable to poor watershed conditions demonstrates the urgent need for maintaining and improving fire protection, and the wisdom of large-scale forest planting and range reseeding operations in the basin highlands, for reduction of floods as well as for timber and forage production.

Survey units.—In order better to carry out its responsibilities in the flood-control program, the Forest Service established new watershed survey units at the Northern Rocky Mountain and Southern Forest Experiment Stations. The primary responsibility of the western unit will be for surveys in the upper Missouri and upper Columbia River watersheds; that of the unit in the South will be primarily for streams tributary to the lower Mississippi. In carrying out the flood-survey program on assigned watersheds, the Forest Service cooperates closely with a comparable organization in the Soil Conservation Service.

These surveys are revealing that many of the stream channels are now badly eroding, and in those areas where heavy timber cutting has taken place, the channels are in a serious condition. Consequently an extremely costly remedial program of engineering aid will be needed if the forest areas are to provide maximum protection to the water resource.

Watershed research.—Research activities in watershed management progressed materially during the year. Help was given to States, counties, and municipalities and to quasipublic institutions such as city water companies.

A Nation-wide conference of forest-influences research men was held in May 1948 at the Coweeta Experimental Forest in North Carolina. This conference, the first in 10 years, enabled the investigators to unify efforts, achieve better correlation in research methods, and discover current deficiencies in programs. Outstanding was the demonstrated need for greater emphasis on soil research as well as for more work on snow accumulation and melt, particularly as related to forest-cover conditions.

That watershed research is greatly valued has been forcibly demonstrated. When because of insufficient funds the question arose as to whether the San Dimas Experimental Forest could continue in operation, the State of California made a special appropriation to continue the work. In addition, the State forester has undertaken to finance a series of publications summarizing many of the results of work already done.

For several years the Interstate Commission on the Delaware River—"Incodel"—has, in cooperation with the State of Pennsylvania and other public and private groups, sought congressional recognition of the need for studies of forest and water relations in this area. In

order to get this work started promptly, Incodel, in cooperation with the State and other agencies, procured an experimental forest and turned it over to the Northeastern Forest Experiment Station. A dedication ceremony was held on this area in May following news that the Congress had provided funds for beginning research on Delaware Basin problems in fiscal year 1949.

The effect of the shelterbelts on snow in the Great Plains region has stimulated thinking that there may be large opportunities to save water that might otherwise be lost in semiarid regions. Shelterbelts planted at right angles to the prevailing winds at high elevations in relatively open areas would accumulate snow throughout the winter. Then, protected by trees, melt would be greatly delayed and water would be made available for later spring or early summer flow. Trials already show possibilities. In Utah, using snow fences as shelterbelts, snow has been accumulated to great depths. The snow became very dense and remained unmelted for weeks after other snow has disappeared.

Evidence is also accumulating that frost in the soil is a most important factor in spring floods such as are common in the Northeast and Ohio Valley regions. The soil of burned, logged, or trampled areas usually freezes, sometimes quite deeply, in early winter. This frost often persists even under a heavy snow blanket, so that any thaw results in immediate and rapid runoff. On the other hand, forest soils which have not been disturbed and which have a good mulch of litter and humus, are not so likely to freeze. Instead they retain their open, porous character. If they do freeze, the frost in the soil is of a honeycomb or crystalline character which, during a sudden thaw, permits the water to infiltrate into the soil. Measurements taken in the Northeastern States for the past several winters indicate that the presence or absence of soil frost and its character is probably more responsible than any other one factor in determining whether a thaw will or will not produce a flood.

Research at Coweeta continued to demonstrate that abuse of the forest is at the root of many serious water and soil problems. Building of logging roads in the southeastern mountains usually means operating a bulldozer up a slope at the highest possible angle the machine will work. As a result roads are "pushed out" by the bulldozers often with grades in excess of 20 percent. Few drains are put in such roads and no effort is made to hold the loosened soil. As a result, the quality of the water in a stream reflects almost immediately the presence of a logging job. Repeatedly, streams that had contained only a very few parts per million of solid matter when their watersheds were undisturbed, jumped to several thousand parts per million with the advent of logging. And such turbidity does not clear up with the cessation of logging. Instead it continues indefinitely because the raw sores of skid trails and logging roads continue to erode long after timber cutting has ceased. Logging that is done without regard for the water resource—and most logging in the Southeast is done that way—is perhaps the greatest single contributing cause of flashy floods, eroding channels, and declining fishing. No solution to this problem, even on the national forests, has yet been found. On the national forests it probably lies in greater insistence by the Forest Service on carefully planned and supervised logging operations.

Range Research

Research in the management and improvement of range lands continues to yield knowledge useful in increasing forage and livestock production. The Forest Service range-research program includes determination of the relative grazing values of various range plants, of desirable seasons to graze various types of range, of grazing capacity on different range types, and of utilization standards or guides to range conditions and trends. It also includes study of the suitability of different types of range for various kinds and classes of livestock, the management of livestock on the range, restoration of depleted range, and other matters affecting sustained high forage and livestock production.

Better management procedures.—On the Jornada Experimental Range in the semidesert country of New Mexico, where annual rainfall averages only about 8 inches, beef production per breeding cow has been almost doubled through good range and cattle management. In the early 1920's, calf crops on this range averaged approximately 74 percent and calves weaned at about 275 pounds. Even these figures were above the range average for southern New Mexico. During the past few years, calf crops on the same area have averaged 90 percent, and the calves 411 pounds at weaning. This increased production has come about chiefly through better management procedures developed from research: More conservative stocking, deferred grazing of parts of the range, better seasonal use generally, and the use of supplemental feeds during drought periods and at other times when they were economically desirable.

Increases in production have also been secured experimentally with cattle in the plains of eastern Colorado and in the foothills of California, and with sheep on desert winter ranges in Utah. Worth-while leads to better management practices are continually coming from the range research.

The advantages of moderate as compared to heavy stocking, aside from larger calf crops, heavier calves at weaning, lower feed costs, and higher salvage values of cows, have become evident after 14 years of contrasted grazing in the northern Great Plains near Miles City, Mont. Soils on the heavily grazed areas were more compact, with less pore space, and had only one-third to one-half as much litter as on soils where grazing was moderate or light. As a result, the soils of the moderately and lightly stocked ranges absorbed water from two to four times faster than those of the heavily stocked ranges. Moderate grazing by cattle permits greater absorption of rainfall into the soil and reduced surface runoff, thus checking erosion and loss of fertile topsoil and promoting better plant growth.

Reseeding.—To aid in reseeding depleted ranges, many species and strains of grasses and legumes from different parts of the world have been tested in nurseries in the western, southern, and southeastern regions. Tests of the preference of grazing animals for a number of species, conducted in the intermountain region, show that preference value changes during the growing season and that some little-known species have a higher preference value than crested wheatgrass, an introduced species which has been seeded successfully on a good many thousand acres of deteriorated range land. Although only a few were tested, legumes generally were higher than grasses in preference

value for cattle. Smooth brome, tall oatgrass, and intermediate wheatgrass all proved to be high both in yield and preference. Extensive plantings of these species will materially increase forage production on range lands.

By applying the reseeding knowledge developed through research, private stockmen have successfully reseeded more than 680,000 acres in Utah, Idaho, Nevada, and southwestern Wyoming. In addition, the Forest Service has reseeded more than 150,000 acres of national-forest range land in the intermountain region.

Many range types throughout the West and in the South and Southeast still remain to be studied. The "know-how" has not yet been developed for reseeding many sites and types that will not revegetate naturally even with good management within a reasonable length of time. Continued and expanded search is needed for new forage species and strains adapted to severe environments and resistant to erosion and grazing use. Methods of seeding slopes too steep for ordinary equipment are needed. The conversion of brushlands into productive range by removing the brush followed by reseeding and good management is a challenging problem throughout the West. In the South and Southeast the job ahead is to discover species, varieties, and strains of forage plants which will give maximum improvement in forage values and the greatest possible duration to the effective green-forage period and to develop economical methods of seeding them on cut-over forest range lands.

In addition to these widely recognized needs for additional research, many special yet highly important problems exist. Many national-forest ranges in the West have become infested with *Wyethia*, an aggressive perennial forb of low forage value. Conversion of infested areas to the production of range forage is a problem still to be met. Similarly, vast acreages now in tarweed, goatweed, or dandelion, but capable of producing good range forage, need to be converted. The methods and procedures for accomplishing this task are not yet known and can be developed only through research.

Cheatgrass brome, an aggressive annual grass, has invaded millions of acres of range land throughout the West. It provides some forage on spring sheep ranges, but later in the season it becomes a hazard due to high inflammability and the presence of awned seed. How to remove cheatgrass, as well as the even more fundamental questions of whether it should be replaced by perennial species, and, if so, will the increased forage values justify the expense are additional questions that remain to be answered.

Forest Economics

Forest survey.—Considerable progress has been made toward completion of the Nation-wide forest survey. This inventory of the Nation's strategic timber resources, authorized by the McSweeney-McNary Act of 1928, is designed to obtain basic information on forest areas, timber volumes, ownership of forest land and timber, rates of timber growth, the drain on timber resources through cutting and destructive agencies, and prospective requirements for timber products. Such information is essential both for the formulation of sound forestry policies and for business decisions of forest industries and landowners.

Initial field inventory work was completed during the year in Arkansas, Missouri, and Illinois; and substantial progress was made in New Hampshire, Vermont, New York, West Virginia, Montana, and California. Resurveys also were made in a number of States where the initial surveys were made a decade or more ago or where there have been marked changes due to growth and cutting. These resurveyed areas included portions of Mississippi, Minnesota, Michigan, Washington, Oregon, Idaho, and South Carolina. In both initial work and resurveys, continued attempts are being made to improve statistical methodology and methods of aerial-photo interpretation. To meet the many needs of public agencies, forest industries, and others for complete and reliable data on forest resources, the Forest Survey should be completed as rapidly as possible.

Policy advisory functions.—Because of world-wide shortages and the strategic importance of timber products, increasing attention has been given to forestry problems in national and international policy formulation. At the request of legislative, executive, and international agencies, a number of advisory reports in this field were prepared on a variety of forest and timber industry problems. These included, for example, an analysis of prospective timber supplies and requirements of countries participating in the European recovery program, with particular emphasis upon the role of the United States in meeting Europe's timber needs. Statements on the domestic supply and requirements situation for lumber and other forest products also were prepared for the Krug Committee on Natural Resources and the Harriman Committee on Foreign Aid. As in previous years, the Forest Service supplied the Food and Agriculture Organization of the United Nations with current data on forest resources and output of timber products. Reports to the Munitions Board analyzed the adequacy of United States timber resources to meet probable requirements, and measures required to meet needs for timber in time of emergency.

Other economic studies.—Among the economic obstacles to forestry in the United States is a pattern of ownership involving several million owners of small holdings, nonresident ownership, and a general lack of understanding of the potentialities of forestry. To determine the relation of forest-management practices to size and kind of ownership, factors influencing the intensity of management, and promising means of achieving better forestry, studies of forest-land ownership are being made in selected areas of the South, Northeast, and west coast. Other studies of the economics of forest management also are under way in several regions to determine the possible production and income from timber and range-land use, and policies necessary for continued support of local labor and industry. The importance of improving marketing facilities as a means of aiding both producers and consumers of forest products also has been recognized in the establishment of investigations of markets and prices for farm forest products under the Research and Marketing Act. These and other economic investigations under way are designed to indicate the conditions necessary for profitable management of timber resources.

Forest Products

Forest-products research is aimed at more complete and efficient utilization of the forest crop through new and improved mechanical

and chemical conversion processes, through better harvesting methods, through the removal of obstacles standing in the way of the utilization of neglected species and waste of various kinds, and through improvement in the serviceability of wood and wood-base materials. This work is centered at the Forest Products Laboratory, Madison, Wis. An account of some of the year's activities follows.

Wood sugar.—One of the most promising potential uses of large quantities of low-grade wood and wood wastes is as sugar for industrial chemicals and livestock feed. One ton of pure wood, free of moisture, yields approximately one-half ton of sugars. The yield is less for some species than for others and is also reduced when much bark is used. Nevertheless, sugar can be made out of practically any wood, with or without bark. There are two major fields of industrial use for wood sugar: the production of industrial chemicals, such as ethyl alcohol, butanol, glycerine, and 2,3 butylene glycol; and the production of molasses or yeast for the feeding of poultry and livestock. Much of the recent work has been concerned with molasses. So far more than 20 tons of wood molasses have been prepared in the Laboratory's wood hydrolysis pilot plant and shipped to various agricultural experiment stations for feeding tests. Tests are under way on dairy and beef cattle, lambs, calves, hogs, chickens, and turkeys. Although none of these tests has been concluded, no unfavorable results have been reported to date. Little has been done as yet on the production or feeding of yeast made from wood sugar.

Hardwood sawlog grades.—There has long been a need for specifications that will permit the segregation of sawlogs into quality classes according to their yields of the various grades of lumber. They would provide the timber owner the opportunity of realizing the full value of the logs he markets, the lumber manufacturer the option of buying quality classes of logs that best meet his requirements, and the forester with the means of making more accurate inventories and appraisals. Work begun some time ago on hardwoods was completed, and there is now available a set of hardwood sawlog grades for application on a national basis. Work has been started on the development of southern pine log grades.

Rayon pulps from hardwoods.—In its work on the development and improvement of chemical and mechanical processing treatments for pulps to improve their quality and render them suitable for new uses, the Laboratory demonstrated that viscose rayon pulps can be produced in good yield and of good quality from hardwoods by both the sulfate and semichemical processes with and without hydrolysis of the wood prior to cooking. It was also shown that the quality of groundwood pulps from a variety of hardwoods and softwoods could be improved by bleaching with sodium peroxide and calcium hypochlorite. Neutral sulfite semichemical pulping procedures also were developed for making pulps for creped insulating paper from hardwood and softwood mill waste.

Paper surfacing for plywood.—The use of resin-impregnated paper as a surface sheet for veneer or plywood gives great promise for improving the abrasion and scuff resistance of wood, improving paintability and resistance to face checking, and upgrading low-quality veneers. A study was made of the effect of the resin content of the overlay paper on abrasion resistance, water-vapor transmission rate, dimensional stability, strength, stiffness, and loss of strength upon

wetting. The results are proving useful to manufacturers in selecting the minimum resin content permissible to achieve desired properties in the surface sheet.

Nailing.—Although nailing is one of the oldest and most commonly used means of fastening wood members together, little attention has been given to a recommended practice or standard procedure for good nailing. To fill this important gap in technical literature on home building, the Laboratory, in cooperation with the Housing and Home Finance Agency, issued a publication on the "Technique of House Nailing." Based on data obtained from tests, observations of nailing practices, and information from architects, engineers, and carpenters, the publication gives nailing procedures to insure satisfactory strength and rigidity of the structural parts of a house. The booklet contains over 50 illustrations of good nailing practice so that it is of considerable value to the apprentice as well as to the more experienced carpenter.

Results of a study of equipment requirements and methods involved in fabricating simple lines of products at small mills were incorporated in the publication, *Fabrication of Wood Products of Small Sawmills and Woodworking Plants*.

Research and technical services were provided by the Laboratory to the Army, Navy, and Air Force to assist them in solving various problems connected with their use of wood and wood-base products.

TROPICAL FORESTRY

National-forest administration, forest research, and State and private forestry cooperation activities are consolidated in one organizational unit in the Forest Service's tropical forestry region, with headquarters in Rio Piedras, P. R. This unit is called upon to deal with complex forest types, land-use problems, and social conditions that are peculiar to the Tropics.

Caribbean National Forest

The Caribbean National Forest in Puerto Rico is one of the most intensively used areas in the national-forest system. In general its greatest value is the protection its forested lands afford to the watersheds that lie above some of the island's most important water-source reservoirs on which over one-quarter of the population are dependent for hydroelectric power, domestic water, and irrigation water for the drier lands along the south coast. Through timber-sale operations the national forest furnishes continuous supplies of whipsawn lumber, small round posts and poles for light construction and other uses, and large quantities of charcoal for cooking fuel. Natural or wild timber stands occupy about three-quarters of the national-forest area. Artificial reforestation of the remainder of the area has now been completed, and the plantations 6 to 8 years old have already begun to yield posts, poles, and fuel wood. The national forest also yields a variety of byproducts such as bananas, citrus, avocados, and other tree fruits, coffee, palm-leaf sheaths for small rural houses, vines for basket making, cut forage for livestock, etc.

The Caribbean National Forest also serves important recreation needs. On a week end as many as 5,000 people visit the larger one of two recreational areas, which is equipped with swimming pools, picnic grounds, shelters, restaurant, overnight cabins, mountain trails, and an observatory overlooking the entire eastern half of the island. In a similar period the other area, smaller and with fewer facilities, accommodates as many as 1,500 people.

The national forest helps to meet the chronic unemployment situation on the island. Harvesting of forest products alone provide annually more than 30,000 man-days of employment, and the amount of labor that goes into the final processing of these products is two or three times more. Administration, protection and improvement, and other activities on the Caribbean Forest provide additional employment.

Close cooperation exists between the Federal and Insular Forest Services in Puerto Rico, since the Director of the Tropical Region is, by appointment of the Commissioner of Agriculture and Commerce of Puerto Rico, also the Director of the Insular Forest Service. The insular service administers several insular public forests; it operates the forest tree nurseries, and provides the planting stock for the public lands and for distribution to farmers for establishing woodlots, wind-breaks, and shelterbelts. The Federal service handles the tropical forest research, authorized and financed by congressional appropriations.

Tropical-Forest Research

The Tropical Forest Experiment Station at Rio Piedras is the research division of the Tropical Region. Although small, it is the leading forest research institution in tropical America. Its facilities include a laboratory, herbarium, wood-sample collection, and a library of over 5,000 titles on tropical forestry and allied fields. Field work is performed at three experimental forests as well as at selected sites on the Caribbean and Insular Forests. A wide variety of experimental conditions are available. Over 500 arborescent species are native to the island, many of which are also common to other parts of the West Indies and to Central America and northern South America.

The Station is serving as a center for the exchange of information on tropical forestry. A quarterly journal, *The Caribbean Forester*, is published and distributed to about 600 foresters and others, mostly in Latin American countries. Four hundred forestry terms have been defined and published as a beginning of a Spanish-English glossary of forestry terminology. The volume of foreign technical correspondence of the station is steadily increasing.

Private forestry is benefiting directly from experiments and demonstrations of wood-lot improvement and management in progress on the experimental forests. Studies to date show that community forestry holds much promise for the satisfaction of rural timber needs.

A product of international cooperation in forestry was the publication during the past year by the Caribbean Commission of a report on Forest Research in the Caribbean Area, a comprehensive statement of research in tropical forestry to date and of the research needed in the future. In the preparation of this report the Tropical Region took a leading part.

Forests of Ecuador

The wood of many Ecuadorian tree species has been identified with the correct botanical names, as a result of a wartime survey of the forests of Ecuador, a report on which was issued during the past year by the Forest Service. The names were also correlated with common names used in other countries. Previously the trees and timbers of Ecuador were poorly known. Wood samples were obtained by the Forest Service field party for laboratory tests and tests of durability. More than 30 species of trees in the collection are new to science. This small country on the Equator, with its tropical lowlands and snow-capped peaks of the Andes, has a wealth of timbers. The principal local uses of wood are for construction, furniture, fuel, mine timbers, cross ties, and fencing. Balsa, the lightest of commercial woods, is by far the leading timber exported. During the war, Ecuador contributed 95 percent of the world's production of balsa, which was used for life rafts, floats, and airplane construction. Though exports of other kinds of wood are small, Ecuador exports in addition such valuable forest products as rubber, cinchona bark, tagua nuts, and kapok.

Forest Service field parties also made wartime surveys in Chile and Costa Rica, with special emphasis on war projects. It would be of mutual benefit to conduct peacetime surveys, in cooperation with local authorities, in other Latin American countries.

FOREST SERVICE PERSONNEL

Recruitment.—With the majority of war veterans returned to their jobs and with no emergency projects under way, attention in personnel management during the year was concentrated mainly on making needed corrections or improvements in certain personnel matters that had carried over from the war years. The remaining slack in junior professional recruitment was taken up by the appointment of additional eligibles from the 1946 Civil Service register, and a few from the new examination that was held during the year. The first postwar unassembled examination was held to provide eligibles for research positions in higher professional grades, and 14 appointments were made from the resulting register.

During the year 45 employees retired, with average Government service of 31 years, and average age of 62 years. An additional 34 retired because of disabilities.

Training.—Most of the Forest Service regional offices held orientation training camps during the year for the newer professional recruits. For the first time psychometric tests were given to all the trainees, and "norms" for some 350 junior professionals are now available. Group training for older employees also was conducted more frequently than during the previous several years. A short course in conservation was resumed in cooperation with the University of Montana. Primary emphasis, however, was given to on-the-job training.

The Forest Service cooperated in a Pan American program of in-service training by providing a year's training in forestry for four trainees from Brazil, Costa Rica, Argentina, and Bolivia. At the end

of the year arrangements for similar training were made for three additional trainees from Mexico, Guatemala, and Argentina.

Safety.—The intensified all-Service safety program began to show tangible results during the year. The injury-frequency rate decreased for the first time in several years. But even granting the hazardous nature of much of the Forest Service's work, preventable serious accidents were still too frequent. Emphasis on safety will be continued.

Housing.—It has been the policy of the Forest Service to provide housing, at fair rentals, for certain classes of field employees in those situations where isolated location, frequent transfers of personnel, or other circumstances necessitate such housing. Lack of adequate housing for field personnel has become an acute problem on many of the national forests and experimental areas. Funds available for maintenance have been so restricted that there has been very little maintenance or replacement of deteriorated structures, and almost no new construction of ranger dwellings, ranger offices, guard cabins, and bunkhouses since before the war. Many existing structures lack adequate sanitary systems and other facilities. Many rangers and other field personnel are having to reside in tourist camps, trailers, temporarily converted office buildings, or other places not designed for regular living quarters. Many have to travel excessive distances to their work because no housing is available close by. The construction of new access roads and the opening up of previously isolated timber stands is creating need for additional housing, if Forest Service personnel are to live near the location of their work.

The Forest Service has been losing some good men, and failing to get certain good men, because it is unable to provide adequate housing for these men and their families. It is highly gratifying that so many employees "stick with" the Forest Service in spite of these and other difficulties. But in the interests of morale, efficiency, and fulfillment of a moral obligation to those who are giving devoted public service, an expanded program of housing for field personnel is urgently needed.

STATEMENT OF RECEIPTS AND EXPENDITURES

National forests.—Receipts from the national forests during fiscal year 1948 totaled \$24,956,254, of which there is held in suspense pending determination of proper disposition \$589,229 from revested Oregon and California Railroad Company grant lands and \$130,594 in Alaska from the Tongass Forest, leaving \$24,236,431 for deposit to the Forest Reserve Fund. Of this total, \$20,594,286 was from timber; \$2,898,315 from grazing; and \$743,830 from special land uses, water power, etc. Of the amount credited initially to the Forest Reserve Fund \$57,120 was returned to Arizona and New Mexico on account of State school lands within national forests and \$137,584 was appropriated for acquisition of national-forest lands. Distribution of the remainder was as follows: Paid to States for benefit of public schools and public roads of the counties in which national forests are situated, \$6,010,432; appropriated for expenditure by the Forest Service for roads and trails within national forests, \$2,404,173; balance to the general fund of the United States Treasury \$15,627,122.

Expenditures for national-forest operation, protection, and management were \$31,976,677. Additional expenditures from appropriations for forest roads and trails amounted to \$12,293,424. A total of \$835,692 was expended for acquisition of national-forest land.

Aid to States.—Forest Service expenditures for cooperation with States and private agencies in fire control, planting, and assistance in forest practice were \$9,638,022.

Research and miscellaneous.—Expenditures for forest research were \$4,670,839; for flood control, \$977,206; general administrative expense, \$648,588.

There was also expended \$4,655,692 for fire control, slash disposal, improvement work, timber stand improvement, and other work financed by outside agencies and from funds derived from national-forest resources. Also, services for insular Government, Puerto Rico, \$4,742; emergency reconstruction and repair, \$11,128; and from proceeds of sale of parts and equipment, \$978,889.

Services for other Government agencies involved expenditures of \$2,948,245, including \$2,289,845 for the Office of the Housing Expediter; \$232,895 for the Army; \$107,522 for the Navy; and \$317,983 for other agencies.

Total net expenditures were \$69,639,144. In addition, expenditures for which appropriations were reimbursed amounted to \$5,087,195. These expenditures were accounted for by objective and functional classifications under 101 separate appropriation titles.

The Forest Service handled the naval stores conservation program involving payment of \$669,869 from funds of the Production and Marketing Administration.

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REPORT

of the

Chief of the Forest Service

1949

New Knowledge in Forestry



UNITED STATES DEPARTMENT OF AGRICULTURE

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., September 15, 1949

HON. CHARLES F. BRANNAN,
Secretary of Agriculture.

DEAR MR. SECRETARY: Our Nation faces the task of creating lasting prosperity at home, and of helping to bring about improved economic conditions in other parts of the world. Abundant resources will be necessary for this task. And that includes the resources of the forests.

The war taught us how essential forest resources are to self-preservation and national strength. We are learning in the postwar years how essential the forest resources are to a progressing peacetime economy and how impairment of those resources is one of the dangers that may throw our economy out of gear.

Wise management and use of our forest resources depends upon sound knowledge. Through well-organized research we can learn how to increase forest productivity and achieve more effective conservation. Research can show us better ways of doing things, at lower costs.

Because of the importance of research in our efforts toward permanent forest abundance, special emphasis has been given in this year's report to the research program of the Forest Service.

Sincerely,

Lyle F. Watts

LYLE F. WATTS,
Chief, Forest Service.

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REPORT

of the

Chief of the Forest Service

New Knowledge in Forestry

The Forest Service is charged with responsibility for promoting the sound management and productive use of this Nation's forest lands—nearly one-third of all lands in the United States. To this end, it administers the publicly owned national-forest system, and cooperates with State agencies in programs aimed at extending fire protection, encouraging reforestation, and providing aids toward better handling of forest lands in private ownership.

Sound management of forest and range lands, public or private, depends upon sound technical knowledge. The principles of good forestry and range practice must be based upon accurate knowledge of how trees and grasses grow, how they respond to various methods of treatment, how they are affected by soils and climate, their relationships to other biologic elements of the forest, and the economic factors and all other factors involved in their growth and utilization. Research is therefore a necessary and fundamental part of the Forest Service program. It has been so from the beginning.

Forestry got started in this country only a little more than a half century ago. There was no American background of knowledge. Few persons here had ever tried—or even thought of—managing forests for continuous production.

Forestry had long been an established practice in Europe. There were professional forestry schools in several European countries; an impressive body of scientific literature on forestry already existed. But European forestry did not fit American conditions. Here the trees were different; the soils and climate were different; there were hundreds of commercial species and scores of forest types to deal with, in contrast to Europe's few. Numerous interrelated range forage types added to the complexity of new problems involving forest grazing and wildlife use. Forestry in the United States had to start almost from scratch.

During the past half century, research and experience have provided many sound guidelines for good forest and range management in America. The pioneering work has pointed the way to many operations that are now standard practice. We can go ahead confidently in managing forests and wild lands for permanent productivity, provided the pace of research and inquiry is adequate to furnish the necessary foundation of technical knowledge. For we still have much to learn. Even as we solve some problems, the rapidly changing forestry picture presents many more needing solution.

ACCOMPLISHMENTS IN RESEARCH

Governmental forest work began with fact finding. Prompted by petition from the American Association for the Advancement of Science, Congress in 1876 authorized the Commissioner of Agricul-

ture to appoint a special agent "to prosecute investigations and inquiries" as to consumption, importation, and exportation of timber and other forest products, the probable supply for future wants, and the means best adapted to their preservation and renewal. Study of forests and forestry methods was for many years the principal job of the Division of Forestry which came into being in the Department of Agriculture a few years later. A timber-testing laboratory was at one time set up in the basement of the old red-brick Agriculture building which formerly stood on the site of the present Department of Agriculture administration building in Washington.

The Forest Service was established in 1905, and 3 years later began to operate its first forest experiment station—the Fort Valley Station on the Coconino Plateau in Arizona. Other stations were soon established in Colorado, Idaho, Washington, California, and Utah. Pioneering research at these stations and elsewhere produced much knowledge to aid the advancement of fire protection, timber management, range management, watershed management, and wood utilization. The Forest Products Laboratory, established in cooperation with the University of Wisconsin in 1910, began almost immediately to produce results worth millions to lumber manufacturers, wood processors, and consumers. It has become the world's outstanding institution for the scientific study of wood and its uses.

Thus, from the beginning the Forest Service recognized the need for new knowledge.

For the most part, however, early-day research at the forest and range field stations attacked immediate problems in the management of the national forests. The McSweeney-McNary Forest Research Act of 1928 gave further recognition to the Federal responsibility for research applicable to private forest lands as well as public lands. It reflected a growing interest in forestry among private owners, and a wider recognition that private forest lands, which represents three-fourths of all our commercial forest land, are the key to forest production.

The McSweeney-McNary Act provided a broad charter for a forest research program in the United States. Under its provisions the Forest Service continued to establish regional forest and range experiment stations to serve the principal forest regions of the country. These brought together under one regional director the various experimental projects under way in each region, and provided central headquarters for the coordination and development of region-wide research programs. Several of the forest experiment stations were set up in cooperation with State universities and are housed on their campuses. The 11 regional forest and range experiment stations now maintained by the Forest Service, and their headquarters, are:

California.—University of California, Berkeley, Calif.

Central States.—Columbus, Ohio.

Intermountain.—Ogden, Utah.

Lake States.—University Farm, St. Paul, Minn.

Northeastern.—Upper Darby, Pa.

Northern Rocky Mountain.—Missoula, Mont.

Pacific Northwest.—Portland, Oreg.

Rocky Mountain.—Colorado Agricultural and Mechanical College, Fort Collins, Colo.

southeastern—Asheville, N. C.

southern.—New Orleans, La.

southwestern.—Tucson, Ariz.

A Tropical Forest Experiment Station is maintained at Rio Piedras, P. R., which is producing much-needed information on the management of tropical forest types. It has become a center for the interchange of technical information among foresters in the Caribbean and Central and South American countries.

A forest experiment station in Alaska also was authorized by the McSweeney-McNary Act, but no funds were appropriated for research in this Territory until 20 years later. An Alaska Forest Research Center, with headquarters in Juneau, was established in 1948 to serve the southeastern part of the Territory.

The McSweeney-McNary Act also authorized a station in Hawaii and an additional station in the Southern States; and an amendment to the act later authorized a Great Plains Forest Experiment Station. Funds for these have not as yet been appropriated by Congress.

A major development since World War II has been the organization of research work centers under the regional forest and range experiment stations, as a means for intensifying research in some of the important resource problem areas. The research centers are set up to meet the needs of areas in which forest types and economic conditions are relatively homogeneous, but all of the work is coordinated in the regional and national programs of forestry research. One or more experimental forests or ranges is maintained in connection with each center as field laboratories where problems can be studied and results tested on a pilot-plant basis.

Forest Service research is under general direction of an Assistant Chief of the Service. His branch of research includes six functional divisions: Forest Management Research, Range Research, Forest Products, Forest Economics, Forest Influences, and Fire Research.

A seventh division, Dendrology and Range Forage Investigations, serves all other divisions of the Forest Service, as well as other agencies of the Department of Agriculture, in tree and range plant identification and other technical matters. This division maintains the Forest Service Herbarium of more than 100,000 specimens. It includes what is undoubtedly the finest collection of annotated western range plants in the country, and is gradually improving its coverage of eastern plants and of tree specimens.

Functionally, the seven research divisions guide and coordinate the work of the regional experiment stations. Administratively, the station directors report directly to the Chief of the Forest Service.

Forest-Management Research

Research in forest management aims to make the business of growing timber stable and profitable. To that end it must discover practical methods of regenerating forests; it must acquire knowledge of the life histories and requirements of trees and learn how to use that knowledge to produce useful timber; it must devise ways to measure volume and growth and to predict yields; it must consider the cost of procedures it develops in relation to gains they make possible; and

it must synthesize all these findings into schemes for regulating for growth so that trees come to maturity in an orderly progression, finishing the maximum return from timber crops harvested regularly and perpetually.

Whenever the natural succession of forest types leads to one made up of valuable species, it is best to favor and assist such trends, going contrary to natural forces in harvesting and reproducing timber crops is often expensive and may lead to complications difficult to cure. Good silviculture, therefore, must be based on an intimate knowledge of the natural development of forests. At the same time, methods used to mold them to highest useful production must be extremely practical, or they will not pay their way.

Forest-management research in the past half century has been influenced by the stages through which forestry itself has passed. Considering forestry as the business of growing timber, there was almost no forestry in America 50 years ago. Timber was obtained then, as it had been since America was discovered, by logging the virgin forests that had grown without man's thought or care. There was no widespread demand for forest research. It was urged rather by the few zealous individuals who could see that even "the pathless woods where rolls the Oregon" could not last forever, and that we must be prepared to grow our own when those were gone.

EARLY STUDIES.—The great contributions of the early years were the descriptive works on American tree species and American forest types. Such classics as Mohr's "Timber Pines of the Southern United States" and Spalding's "The White Pine" appeared as bulletins of the Division of Forestry before 1900. Studies of many other timber trees followed, and by 1912 nearly 100 species had been covered.

The first studies by Federal foresters on practical forest management were chiefly valuable for their missionary effect rather than for the good acts that followed them. Graves' "Practical Forestry in the Adirondacks" and Toumey's "Practical Tree Planting in Operation" appeared at the turn of the century. They were followed by a series of "forest working plans" and by regional treatments of forest species with increased emphasis on silvicultural measures.

Work along these lines culminated in a series of bulletins on timber growing and logging practice for all the major forest regions of the country. This series, published during the 1920's and 1930's, brought together and systematized what had been learned through research and experience on the national forests and elsewhere. It was intended to serve as a guide and encouragement for timber industries that were beginning to try out on their own the growing of the forest products they depended upon. From industries came also the demand for better information on growth and yield of forest stands. The Forest Service made growth and yield studies and compiled volume tables for many species.

More recently, research on nursery practice and on planting methods has helped to lower the costs and increase the success of reforestation in various sections of the country. The work of the Forest Service on naval stores has brought many findings of great value to that industry. Development of acid stimulation to increase gum yield is a notable recent example.

Much forest research has been empirical. Research workers tried a number of methods of cutting and recommended the one that gave the desired results without knowing very much about why those results followed. But some work has gone into the more fundamental things. A few studies have been made on the effects of soil and climate on forest types. Detailed research has been done on the reproduction of several important species. Some special phases of forest management have been more or less thoroughly investigated. The Northeastern and California Forest Experiment Stations have done work in genetics, looking to development of better trees through hybridization.

In the Lake States research has shown how to follow nature in the selective cutting of northern hardwoods, and is approaching the secret of the ideal stand density for that forest type. In the California pine region we have found out how to anticipate the bark beetles and save, by well-timed harvest, great volumes of timber that would otherwise be lost. In the Northern Rocky Mountains valuable crops of western white pine can be grown in spite of the blister rust. Elsewhere in this region, we are learning that through strip cutting the needs for timber products can be met and watershed values protected or improved. In the Northwest practical logging systems are being worked out to get good reproduction of Douglas-fir. In the Southwest, where heat and drought make it nip and tuck between forests and grassland, we have learned to cut little and often, always leaving the best trees. In New England we are learning to live with the spruce budworm and still produce continuous crops of spruce and fir. In the Central States research is showing how to make valuable forests grow on the spoil banks created by surface mining. And in the South is showing that good forestry can pay in a surprisingly big way. Thus, research in forest management has attempted to meet the needs of changing times. Future trends must be anticipated so that research of a long-term nature can be started soon enough to provide the answers when needed. Of utmost importance is intensification of research to determine the most efficient cutting rates and silvicultural measures for converting unmanaged forests to managed forests. Research must be extended to forest types thus far little studied. A small but growing interest in really intensive forest management points to a new era of silvicultural research, and reorientation of forest Service research programs to meet this anticipated need is under way.

With a more thorough groundwork of knowledge in these fields, both public and private land managers can advance to valuable new applications more directly and more certainly. Without it, programs of forestry can move along only by slow, costly, cut-and-try experience. **THE WORK IS GOING AHEAD.**—Important accomplishments of the past year included demonstration that seedling establishment of pines of the shortleaf pine-hardwood type in North Carolina is improved when logging debris is removed and the forest litter decreased by burning or scarification. Similar results were obtained in the loblolly pine type of the Piedmont, and with pitch pine in New Jersey. Uneven-aged lodgepole pine on the Deschutes-Klamath Plateau of the Pacific Northwest is apparently adapted to a flexible selection

system of cutting. In the Rocky Mountains, even-aged management has been found better than partial cutting. These findings indicate the varied behavior of tree species from region to region.

Chemical plant poisons to get rid of unwanted trees and brush are being experimented with in many parts of the country. New developments in the use of chemical weed killers in forest nurseries promise to reduce the need for many man-days of labor for hand weeding, one of the costliest items in raising planting stock.

Experiments were continued with pruning to improve the quality of second-growth timber. At the Pacific Northwest Station, many promising crop trees in a thinned 36-year-old Douglas-fir stand were pruned to a height of 19 feet at a cost of 35 cents per tree. The increase in value resulting from growing clear material should bring profits several times greater than costs. At the Southeastern Station, bud-pruning of slash pine gives promise of being a cheap and effective way of producing knot-free lumber. The bud-pruning is begun when the trees are 3 to 6 feet high.

Severe root rot of seedlings nearly forced the abandonment of the Ashe Forest Nursery in Mississippi. If this disease became common, it could severely hamper reforestation programs throughout the South. Discovery by the Southern Forest Experiment Station that soil deterioration by continual production of seedling crops is responsible for the rot, makes possible a solution of the difficulty. Applications of 30 tons of sawdust per acre to nursery beds resulted in almost complete freedom from root rot for both longleaf and slash pine seedlings.

The Pacific Northwest Station is developing a light hand seedling method that will quickly plant at a selected depth a single pelleted tree seed. The conventional pelleting process was found to destroy or inhibit the germinative capacity of conifer seeds, probably by limiting the available oxygen supply. New-type pellets are being developed which, it is believed, will not retard germination, but will have the usual advantages of pellets: easier handling and a supply of nutrients to the young seedling.

Spiral-shaped metal gutters for use on turpentine trees were developed at the Lake City, Fla., Research Center. Cheaper to install than the old type, these gutters can be used successfully on extra wide faces. Progress was also made in the development of disposable cup power chippers, a combined hack and spray gun for applying acids, and other devices to lessen the costs of naval stores operations.

The Lake States Station has undertaken a study of the growth and yield of the balsam fir-spruce type. Young stands of this type are widespread, and public foresters and pulp and paper companies want accurate information on its future yields. Field work on the study was done cooperatively by nine pulp and paper companies, six national forests, the conservation departments of three States, Michigan State College, the University of Minnesota, and the station.

At the Alaska Forest Research Center, yield tables made 20 years ago for the mixed conifer stand of the coastal region were checked by remeasurement of some of the original plots. Growth in the stands was found to be somewhat less than predicted. It was found, however,

ver, that the pulpwood volume of 80-year-old second-growth stands is nearly double that present in the old virgin stands. The Alaska Center has also started a study of the effects of logging on the salmon in Alaska rivers.

BUSINESS OF GROWING TIMBER.—At the Lake City Research Center in Florida, good management of a 53-acre farm woodland for a variety of products, including cross ties, pulpwood, and naval stores, has brought in over \$8 per acre per year since the experiment was started 5 years ago. During that time the stand has been improved; yields are likely to increase in the future. Similar studies at a number of other research centers prove that well-integrated forest management can be profitable on small holdings.

The Forest Service plans to continue its attack on such problems as how to make the most of aspen in the Lake States and intermountain region, lodgepole pine and true firs in the Northern Rockies and Pacific Northwest, and other species heretofore little used. It will keep on trying to find better, cheaper, and faster ways to reforest the raw earth exposed by surface mining. It will endeavor to work out management practices and control measures that will keep down troublesome forest insects and diseases.

The littleleaf disease of shortleaf pine in the South and the pole blight of western white pine are causing increasing concern. At the present stage of knowledge, these diseases are still mysteries. While pathologists seek the causal organisms, foresters must investigate the environment and physiology of the sick trees and look for ways to handle the stands or replace the species so as to make losses as little as possible.

New tools available to the forester will be further tested to learn how to use them most effectively: 2,4-D and 2,4,5-T and other weed and brush killers; DDT and other new insecticides; airborne equipment to spray forests or to sow seed. Research must also be alert to develop other new tools and processes.

At a large number of research centers, pilot-plant tests on a commercial scale are being made of woods practices that research has shown to be desirable from a silvicultural standpoint. These tests are the final step needed to refine recommendations for conservative, profitable forest management.

Research in Forest-Fire Control

Investigations looking to better control of forest, brush, and grass fires on wild lands were formerly conducted as part of the program of the Division of Forest Management Research. In the fiscal year 1949 a new Division of Fire Research was established in the Forest Service. This was intended to correct a growing lack of balance between the size, importance, and cost of the Nation's forest-fire control job and the research effort being devoted to it. Increases in the value and use of wild-land resources have been at a faster pace than progress in curtailing fire losses. The new division's purpose is to start building a more adequate program of research in order to strengthen the fire-control effort.

Systematic protection of forest resources from fire did not develop as part of the scientific forestry of Europe. In most of Europe climate, species, and close utilization made forest-fire losses a minor problem. In America, the extremes of our continental climate, the great areas of poorly accessible forest land, and the rapid exploitation of our forest wealth combined to make fires one of the big obstacles to the conservation and management of forest lands.

When the national-forest system was started about a half century ago, great fires often burned unchecked over vast areas. The need for preventing such disasters was, indeed, one of the impelling motives for establishing many of the national forests. Fighting fire was the first and biggest job of the newly created Forest Service. It soon became obvious that the control of fires required something more than physical stamina and the will to fight. Scientific study was started both by the administrative organization and by the small but very alert research group.

PLANNING THE FIRE ORGANIZATION.—One of the first major contributions was in planning the fire organization to control fires while they were still small. Time limits or standards were determined by careful analysis of the success or failure of fighting fires in different fuels with varying lengths of time before they were attacked. From the start, systematic studies developed means for speeding up each operation until it conformed to an acceptable standard of elapsed time.

Since in each case large areas of land were involved, the concept of "coverage" of area was developed. Coverage gave a systematic basis on which plans for fire action could be applied uniformly throughout a protected area. A method of locating a system of lookout points was developed which would bring the maximum amount of area under observation at the least cost. In similar fashion the amount of area that could be reached within a specified time from each point at which fire fighters might be stationed was determined. Construction of roads and trails along strategic routes would enable fewer men to control more fires. The mileage of roads and trails that could be justified could then be balanced against the costs otherwise necessary to maintain a large and widely scattered force of men in inaccessible country.

Development of principles such as these converted the protective job into a well-organized and systematic procedure based on technical plans. They made it possible to use the men and facilities available during the Civilian Conservation Corps period to improve permanent facilities for protecting the forests and to raise the standards of accomplishment. Results were clearly evident in the greatly improved record that followed.

FIRE-DANGER METER.—Another important contribution has been the development of methods of measuring fire danger. The first fire danger meter was developed during the 1930's. It is a device which brings together into a single expression or rating the important factors that increase or decrease the danger of forest fires at any given moment. At different times and under different conditions of temperature, humidity, wind velocity, etc., forest inflammability may vary all the way from conditions which make it difficult even to start a campfire up to a situation in which a single match or cigarette stub can

start an uncontrollable conflagration in so short a time as 15 minutes. The variations in danger conditions between these two extremes are often difficult to recognize but they are important to the efficiency of fire-control organization.

The fire-danger meter, which has taken several forms to fit local conditions, is now utilized on all national forests and by a majority of the State protective organizations. It is the basis for deciding when thousands of men must be at their posts or alerted for fire duty. It is also utilized to determine the times and duration of such extreme fire danger that forest areas need to be closed to the public for temporary periods, or other emergency measures taken. Many further uses are in process of development but depend in part on further improvement of the accuracy and dependability of fire-danger ratings. Further research in this field is important and should continue to be most profitable.

NEW EQUIPMENT AND TECHNIQUES.—Great advances have been made in the development of specialized techniques and equipment for fire suppression. Development of the "one-lick system"—a sort of assembly-line technique for fire-fighting crews—greatly increased the speed and efficiency of hand-tool work on the fire line. Numerous types of power tools, pumps, fire trucks, brush busters, and trenching machines have been devised. Such equipment enables fire-fighting forces directly to control hotter and more aggressive fires than could be done by hand methods alone.

The airplane has already contributed a great deal to fire fighting in the back country. The Forest Service pioneered in developing techniques for parachute delivery of men and supplies to back-country areas—techniques that were of great value to the Army in organizing and training the paratroops of World War II.

These more important developments are largely in a field that may be termed "operational research." They represent the joint efforts of the research and administrative groups. Much of this effort has not been highly scientific, yet it has been essential to the development of fire control.

Of equal importance has been the modest but continuing programs of more fundamental research. The more important of these have been concerned with the study of fire itself and how it behaves under all combinations of fuels and weather conditions. Such studies have provided the basis for each fire-danger rating system, and the application of this knowledge is contributing to further improvements in all phases of fire prevention and suppression.

During the year, the new Division of Fire Research concerned itself primarily with better correlation of fire-research activities under way and with the development of a more effective program of research for the future. Some important field work was conducted, however. Tests of helicopters in California demonstrated that they have many practical uses in forest-fire control, and that with further development of performance and pay load, they may make possible direct attack on fires from the air. With the cooperation of Dr. Vincent J. Schaefer of the General Electric Co., the Northern Rocky Mountain Forest Experiment Station began looking into the possibilities of pre-

venting or controlling dry lightning storms by "seeding" thunder clouds with dry ice.

Under adverse conditions, present methods of fighting forest fires are still inadequate to prevent occasional major disasters. Annual losses from forest, brush, and grass fires are still far too big. Modern forest-fire control must now become more intensive and must be fitted more skillfully to the needs and conditions of each locality. The Forest Service plans to intensify its studies of ways and means of preventing fires; the development of improved fire-fighting equipment, methods, and facilities, including control of fires from the air; the physics and chemistry of combustion; and other matters involved in promoting greater efficiency in the prevention and control of forest fires and reducing costs and losses.

In the management of wild lands for maximum production of public benefits, certain beneficial uses of fire must be explored. Fire can become a useful tool under certain circumstances if carefully applied and controlled. Studies in this field have already demonstrated that in portions of the southern pine region fire can be used for forest seedbed preparation, for control of certain tree diseases, and for the elimination of undesired plants and trees. In some circumstances it can be used to get rid of sagebrush on western ranges. However, much is still unknown about permissible uses. Because of fire's potential destructiveness, careful research in this field is especially important.

Range Research

Soon after the Forest Service was established it began studies, in cooperation with the Bureau of Plant Industry, to aid in better management of the range resource—the native forage—and to point the way toward restoring soil and forage values on deteriorated ranges in the national forests that came under its administration. An Office of Grazing Studies was set up in 1910, and in 1912 a range experiment station was established in the mountains of central Utah.

In 1915, general responsibility for research on range problems on both public and private lands was assigned to the Forest Service in the order of the Secretary of Agriculture. The Forest Service took over the Santa Rita Experimental Range in southern Arizona, which had been established by the Department of Agriculture in 1903, and the Jornada Experimental Range in New Mexico, established in 1912.

Range research has expanded until one or more phases are now underway at each of the six western regional forest and range experiment stations and at the Southern, Southeastern, and Central States Stations. Cooperation has been arranged with other Federal agencies with State agricultural experiment stations and extension service and with many private stockmen. This cooperative attack has greatly facilitated the conduct of research and the coordination of methods, results, and application.

Results of this research now apply in some degree to most of the 950,000 acres of range lands in the United States. This vast natural range area, approximately half the land area of the United States

furnishes cheap forage for some part of the year to nearly 75 percent of the Nation's sheep and goats and more than 50 percent of the beef cattle. It also furnishes browse and other forage to thousands of big-game animals. Part of the range land area is in national forests and Federal grazing districts. Some is State-owned. Nearly two-thirds of it is in private ownership.

Improved range management offers possibilities for increased and sustained forage and livestock production, lower costs, and greater profits to stockmen. Improved practices developed by research already have brought millions of additional dollars to stockmen and increased the returns to public agencies for use of their lands.

There is a vast difference between native western ranges and irrigated pastures, or between western ranges and improved pastures in the more humid East. On western ranges, annual precipitation generally averages under 15 inches—low for plant growth at best. Bunchgrasses, which do not form a sod, provide most of the forage. Succulent forbs, or range weeds, and the foliage and tender twigs of shrubs also contribute to the forage supply. In humid or irrigated pastures the heavy cover of turf-forming plants can withstand close grazing, but the bunchgrasses in arid and semiarid ranges grow in thinner stands and cannot withstand such heavy grazing.

On western ranges a critical balance exists between climate, plant growth, and utilization. This makes necessary the development of methods of management especially adapted to the different western range types and conditions. Because of failure to recognize this need, excessive grazing during the settlement of the West resulted in serious range deterioration. Palatable plants were replaced by a thinner stand of less palatable plants. Sagebrush and other low-value shrubs increased greatly, and many foreign annuals crowded in. Grazing capacity was greatly reduced.

Even now, after considerable improvement in some areas in recent years, average grazing capacity of western ranges is little more than 10 percent of what it was originally, or of what it should be now. Reduction of the protective plant cover has permitted the fertile topsoil to be washed or blown away in many areas, increasing the difficulty of restoring range and watershed values.

GRAZING MANAGEMENT.—Early empirical studies developed several basic management practices. These included (1) grazing the class or classes of livestock particularly adapted to each range area; (2) stocking in accordance with estimated grazing capacities (which were determined for several major range types); (3) establishing suitable seasons for grazing the different elevational zones; particularly in relation to readiness of plants for grazing; (4) obtaining more uniform and effective use of the available forage and preventing localized damage to range by better distribution and handling of livestock. Better livestock distribution can be obtained through such methods as improved water distribution, improved salting practices for cattle, and pen quiet herding of sheep and goats and bedding them down in a few place each night.

Restoration of deteriorated ranges has been materially aided by deferred and rotation grazing, which permits full utilization of the forage but delays grazing on a different part of the range each year.

until after seed dissemination or until maturity of those plants which reproduce mainly by vegetative means.

Development of reliable methods of range survey has made possible the preparation of management plans for individual ranches and range allotments. Range surveys, following techniques developed by research, have been widely used by the Forest Service in national forest administration, by the Bureau of Land Management on public grazing districts and by the Soil Conservation Service and the Production and Marketing Administration in aiding stockmen to develop management plans for their ranches.

On a range in good condition, the fertile, friable soil is well protected by an abundant cover of grass and other vegetation. It absorbs precipitation readily and is therefore not subject to accelerated erosion. It produces a large amount of palatable forage for use by livestock or game or both.

On the other hand, ranges in unsatisfactory condition produce less forage, the soil is inadequately protected against erosion, and is usually more compact and less fertile. With each stage of deterioration from fair to poor, and eventually to very poor, the situation on a range area becomes more critical both as to production of forage and restoration of plant cover. Effects of the thinner stand are reflected in such things as more rapid run-off, less absorption of moisture by the soil, greater evaporation, increased requirement of water for the production of a given quantity of forage, and more damage from prolonged dry spells. The loss to the livestock industry and to the Nation from such unsatisfactory conditions is obvious, as is the need for restoring plant cover as rapidly as possible.

Numerous experiments with both cattle and sheep have proved that increased forage and livestock production can be obtained from conservative stocking and other phases of improved management. For example, in a 6-year study (1942-47) at the Manitou Experimental Range in Colorado, yearling Herefords were grazed on one area of ponderosa pine-bunchgrass range at an average rate of 39 head per section (640 acres) for a 5-month season—the estimated grazing capacity. A comparable area was overstocked at 54 head per section. On the conservatively stocked range, the animals gained an average of 220 pounds; on the overstocked range, 180 pounds. The better developed animals on the conservatively stocked range sold for \$1 more per hundredweight. Average net returns per section were \$735 under moderate stocking, \$484 under heavy stocking. The heavy stocking, moreover, resulted in cumulative forage and soil deterioration. In 1948 the overstocked range produced only 163 pounds of herbage per acre in contrast with 380 pounds on the moderately stocked range.

Research in North Carolina indicates that beef-cattle production can be highly profitable on good switch cane or reed ranges in the Southeast. Only mineral supplements are needed to maintain breeding cows in thrifty condition from May through January and for them to produce calves weighing 300 to 400 pounds at weaning time in November. The grazing season can be extended from January through May by using an area ungrazed during the previous summer

and fall, and by feeding protein supplements. Such wintering on the range is far more economical than wintering in the feed lot. By supplying the essential roughage in the fattening ration, good switch-cane range also can be used for fattening steers.

RANGE RESEEDING.—Reseeding offers possibilities for rapid restoration of millions of acres of western range lands, public and private, that are now badly depleted. In the piney woods section of the South it offers possibilities for lengthening the season of palatable and nutritious forage and thereby reducing the need for feeding supplements. This objective may likewise assume greater importance in the West after species and methods for range restoration are more adequately developed.

Early studies sought primarily to adapt farm practices to range reseeding. Mountain meadows having favorable soil and moisture conditions were successfully seeded, but costs were high. Limited studies on other range types gave some leads, but success could seldom be assured. About 15 years ago the Forest Service began intensive experiments in the northern plains and on foothill and valley ranges of the Intermountain Region. Similar studies were extended to several other sections of the West and the South in 1945. Through low-cost research procedures, using thousands of small range-plot tests, the particular species best adapted to each range site are being determined.

Successful seeding techniques have been worked out for a number of range types: How and when to seed, how much seed to plant, seeding depth required, etc. Too light seeding permits other plants to use the soil moisture and hampers establishment. Too much seed unnecessarily increases costs, may cause losses from competition, and may result in lower yields of forage. The single-disk drill has proved best for planting on most range sites. Successful broadcast seeding has been accomplished, however, on recently burned timber and brush lands where the seeding was done before the loose ashes were settled or washed by heavy rains. Airplanes offer a rapid and economical means of seeding such areas. During the past year, the Forest Service made a thoroughgoing test of airplane seeding with pelleted seed in southeastern Utah. Full results are not yet determined, but it appears that pelletizing reduces the germinating power of the seed, and so far has not given a satisfactory stand.

Recent studies indicate that selection of improved strains is desirable with range grasses. Among some 28 strains of smooth brome in the foothill zone of central Utah, for example, production varies from less than 1,000 to more than 6,000 pounds of herbage per acre. Only a few smooth brome strains are able to survive in the aspen zone at 8,000 feet elevation; only two at 10,500 feet.

Economical methods are being worked out for removing the big sagebrush that occupies many favored sites for reseeding. One difficulty has been the frequent break-down of equipment when used on rough, rocky range land. The Forest Service has developed a new, rugged brushland plow, with "knee action" features, which does an excellent job of sagebrush removal, with breakage greatly reduced.

Many stockmen are cooperating in tests to determine the grazing value of reseeded range lands. Range areas seeded by practices proved experimentally now often produce 10 to 20 times as much forage as they did before seeding. Costs have varied from \$1.20 to about \$8 per acre; grazing value of the land has increased \$8 to \$12 an acre. And there are many indirect values, such as erosion control, better balance of the forage supply throughout the year, and more efficient livestock production.

More than 5,000,000 acres have been successfully reseeded with procedures developed by Forest Service research. About 10,000,000 additional acres in the West can now be seeded successfully at reasonable cost if these proven procedures are followed. There are, however, more than 70,000,000 acres of western range lands in need of reseeding for which proven practices cannot as yet be outlined.

CONTROL OF UNDESIRABLE PLANTS.—Besides the sagebrush already mentioned, many other undesirable shrubs have invaded range lands, using the available moisture and preventing millions of acres from producing the grass so badly needed for economical livestock production.

Some 60,000,000 acres in the Southwest are infested with mesquite. Juniper, cholla, and pricklypear cactus also are widespread. Studies in Arizona by the Southwestern Forest and Range Experiment Station have developed methods of killing mesquite for as little as \$3.50 an acre. In a few years several times as much grass forage is available as before treatment. The studies are continuing, looking to more effective and more economical control procedures, especially in heavy mesquite stands.

Cheatgrass, which causes a critical fire problem, orange sneezeweed, burroweed, St. Johnswort, and numerous other worthless, poisonous, or otherwise undesirable plants occur in extensive stands on from one-fourth to one-half of the range lands of the West. Research on control of such worthless or noxious plants is just getting under way on a limited scale far short of the need.

OTHER WORK PLANNED.—Pinyon-juniper areas of the Southwest, Piedmont and coastal prairie ranges of the South, and extensive and varied range areas in Texas offer opportunities for greater and more efficient range livestock production. These and a number of other important range types in the West have not yet been carefully investigated. Then, too, there are areas where conflicts in use—such as between livestock and big game—call for more knowledge than is now available.

Thousands of farm woodlands in the Central States are being grazed because they provide shade for livestock or have a small forage value. There is little doubt that such grazing is preventing satisfactory timber reproduction and slowing down forest growth. In the West, grazing practices have been evolved that prevent serious damage to timber reproduction. Whether suitable grazing techniques can be worked out for the corn-belt wood lots is a problem for research.

Fundamental as well as empirical studies are necessary. There are thousands of range plants. These differ greatly in their life processes, their life histories, requirements of soil, moisture, and light, and value

as forage. Over the years considerable knowledge of the growth requirements of the more important range plants has been developed, together with some indication of their ability to withstand grazing in different periods of their growth. But there are a vast number of secondary plants now abundant on deteriorated ranges for which adequate knowledge is not yet available.

Little is yet known regarding the true nutritive value of the vast number of range plants. In some instances, seasonal values justify special management consideration. This is especially true of forest areas of the southern and southeastern coastal plains. Enormous quantities of herbage are produced under the forest canopy but they are low in nutritive value for a large part of the year.

Fertilization of some range lands may both increase forage production and improve nutritive qualities. Limited studies on fertilizing ranges in the South and in the foothills of California indicate certain potentialities.

In another decade many of the studies now under way, and others which should be undertaken promptly to meet urgent problems, should culminate and their results pass into practice. Much information now available only in rough form will be refined for efficient application.

Experience often develops improved management, but is apt to be slow and costly. Research offers the opportunity for developing better range practices and testing their applicability at low cost. Range agriculture in the United States is a complex of interdependent crop farming and wild-land grazing. The welfare of hundreds of thousands of individual farmers and stockmen, of thousands of local communities and even metropolitan centers, reflects adversity or prosperity on the range. Too frequently improper range management has resulted in reduced livestock production, increased costs, overinvestment, and eventual tax delinquency, bankruptcy, deserted homes and schools, and blighted hopes. In times of prosperity, such results may be less apparent. They are emphasized, however, by droughts and depressions—and especially when these coincide. Maximum production can be sustained, and communities dependent on the range resource stabilized and maintained, only when sound range management is applied. The goal of range research is to find how all range lands can be made to provide the maximum in forage and livestock production, in watershed protection and other benefits—in short, in human welfare.

Forest Influences

Research in forest influences is directed toward solving the many soil and water problems that have developed from use of forest and range resources and the growing demand for water supplies and flood control. Solution of these problems lies in the development and application of sound watershed-management practices. On most wild-land areas these practices should allow other uses, such as timber production or grazing, without endangering soil and water resources. For certain areas of critical watershed importance, special practices will be necessary to protect the watershed from erosion or to obtain and safely maintain the highest usable water yields.

The many problems that have arisen from forest and range use originated from practices which, in disturbing the intimate cover-soil-water relations, produced or contributed to floods, water shortages, and the removal and loss of soil. Besides, quality of water used by home and farm and industry has deteriorated in many localities, while silt deposition clogged stream channels and shortened the useful life of reservoirs.

While these problems affect downstream water users, final solution can only be found at their origin. There, two questions must be answered: How to use the forest and range resources so as to maintain an equilibrium among soil, cover, and water; and how to regain that equilibrium on already upset watersheds.

Still another problem is presented by those areas from which water yield is both limited and precious. Here, of necessity, all management effort must be bent toward protecting that yield, while research is directed towards developing methods of increasing yield without starting erosional processes.

The effect of forests on climate also requires more detailed investigation, particularly as to the effects of shelter belts on wind erosion, farm climate, and crop yields.

PROTECTIVE INFLUENCE.—Before the close of the seventeenth century settlers noticed an increase in floods and in turbidity of the streams and blamed it on heavy cutting and burning of the forests. If clearing and burning had this effect, they assumed, logically enough, that forests had a beneficial influence on stream flow. Though the influence of vegetation on water and soil is still not fully understood, this assumption has become a part of the philosophy of conservation—almost a tenet of faith. It was one of the considerations that led to establishment of the Forest Service, and development of the national-forest system.

Shortly after its establishment the Forest Service began research to measure the influence of forest and range cover on stream flow. Studies were designed to compare runoff and erosion from adjacent forested and clear-cut areas in Colorado and from heavily and lightly grazed areas in Utah. Both investigations showed an increase in stream flow from the cleared or heavily grazed areas, especially during storm periods. Also demonstrated were increases in soil erosion; soil loss was found to be as sensitive an indicator of land use as stream-flow behavior. These studies helped to verify earlier beliefs and emphasized the protective character of the wild-land vegetation.

Further studies led to findings which, summarized, are almost axiomatic: soil loss and water chaos follow wild-land abuse. Examples of such findings follow.

Overgrazing: Tests in the high-altitude water-producing areas of Utah showed that 74 percent of rainfall ran off of heavily grazed plots; 2 percent from lightly grazed. Runoff from the overgrazed areas picks up a load of silt from exposed soil surfaces, concentrates rapidly into high-gradient channels, and in Utah—when storms are hard enough—funnels out on valuable urban and irrigated land as mud-rock flows.

Burning: Runoff from annually burned woodland-chaparral plots in California averaged 14 percent of precipitation; from unburned

plots 0.1 percent. Average annual erosion rates from the burned plots was over 12 tons of soil per acre; from the unburned, 1½ pounds. The disastrous Montrose flood of 1934 in Southern California came from a burned watershed.

Typical logging practices: In the Appalachians turbidity of water from a watershed logged by customary methods averaged 94 parts per million whereas a nearby unlogged area averaged 4. Water from the logged watershed was always muddy after storms and never met the standard set for drinking water, 10 parts per million.

SITE RESTORATION.—Demonstrating the protective importance of wild lands led to investigating methods of restoring areas that had been degraded. Forest-influences research, in this connection, has found methods of combining engineering structures with vegetal controls to stabilize eroding sites. In California, research in roadside erosion control developed methods of supplementing vegetation with engineering structures to stabilize cuts and fills on mountain roads, pointing the way to reducing road maintenance costs and silting of adjacent streams. These methods have since been used by highway departments of several States.

In Utah a combination of contour trenches and reseedling was devised that successfully controlled runoff even from intense storms that produced floods on nearby untreated areas.

INCREASED WATER YIELDS.—As the influence of vegetation on stream flow became more and more evident, it was seen that vegetation might be manipulated to control stream flow. In areas where water supply is the limiting factor to development (and there are many such areas in both the East and the West) research has begun to explore the possibility that water can be conserved by reducing vegetative cover to the minimum required for site protection. Where this is feasible, the benefit to western irrigation agriculture is obvious; and similar benefits could perhaps be realized in parts of the East, where water demand is beginning to exceed supply.

Time has not yet allowed much testing of this possibility. But promising results from studies made thus far appear to justify further investigation. Logically, for each forest region there should be a type of forest that will best conserve water, reduce wastage, and produce the highest water yield. To find out what type that is, and how it may be obtained and maintained requires intensive, prolonged research.

SHELTER-BELT RESEARCH.—The question of how forests might influence climate has been of interest to both laymen and foresters. At one time it was an accepted belief that cutting of forests affected the length of seasons. More recently there was a belief that forests affected the country-wide distribution of rainfall. Influences research so far has indicated that the climatic influence is primarily local and of significance chiefly in respect to shelter belts.

When the Great Plains Shelterbelt Project was undertaken in the 1930's, research workers, by evaluating old plantations and synthesizing a great variety of physical and biological information, devised methods of planting, recommended species to plant, and selected the planting areas. A recent survey attests to the success of the project and the research that preceded and accompanied it.

Recent extended cultivation of semiarid areas has intensified the need for shelter-belt research. Research must develop, either by tree breeding or introduction, suitable trees which can survive the unfavorable growing conditions in these areas. In the northern Great Plains, more rapid-growing species are needed; in the southern part, longer-lived species. Also species must be developed that will allow extension of shelter-belt planting into more arid regions. And in order to get the greatest benefits from shelter belts, more needs to be known of their effect on wind, soil moisture, and snow storage, and on crop yields and livestock returns.

TRANSPIRATION, INFILTRATION, PERCOLATION.—Forest-influences research is concerned with water both as a product and as a destructive force. It is concerned with the effect of vegetation on water, and its effect on soil as a medium for water movement and storage.

Vegetation has an effect on water through interception of rain and snowfall and through transpiration. It affects the water relations of soils: Evaporation, infiltration, percolation, and storage. And vegetation markedly affects soil stability.

In areas of limited water supply, interception is a waste of water. We need to know how much water is wasted by interception in various types, densities, and ages of forest, and the effects of different types of cutting on interception. On flood-source areas, we need to determine which species provide the most interception, and the possibilities for encouraging their growth.

Transpiration—consumption of water by vegetation—can be either beneficial or harmful, depending on whether flood control or increased water yield is the principal goal. Very little information yet exists on transpiration as affected by species, ages, and densities of forest and range cover.

The factors which promote or limit infiltration, and the effects of land use practices on infiltration and on percolation of water through the soil need to be ascertained. Percolation is of particular significance to water storage and yield in those soils which possess hardpans. In these areas, methods of fracturing these impermeable layers to allow greater storage of water in the soil should be studied.

Current investigations are yielding some knowledge in these matters. For example, in the Northeastern States, it has been found that forest soils in good condition maintain a friable, porous structure throughout the winter. Impervious frost does not occur under good forest, although it frequently occurs under poor forest or in agricultural areas. Impervious frost reduces or prevents infiltration and increases surface runoff from winter rains or snowmelt. Concentration of this runoff produces the winter and spring floods common to this section of the country.

Tests in Colorado in areas of sagebrush and sandy soils have revealed that infiltration capacity under heavy grazing is only about one-half that under moderate grazing. Resting an area from grazing for several years resulted in an eleven-fold increase in infiltration capacity.

Snow-drifting studies in Utah point to the possibility of storing snow in the mountains behind either artificial or natural windbreaks

to prolong its melting period. If feasible this would provide a better distribution of water for irrigation in a part of the country where reservoir sites are practically nonexistent.

VALUE OF ACCOMPLISHMENTS.—Discovery of the protective character of forest and range vegetation gave emphasis to watershed protection as a requisite of wild-land management. This static concept has now been replaced with a more positive approach—watershed *management*, the regulation of wild-land resources to improve as well as to protect water yield.

There has been increasing recognition that water is a resource. As in the case of the timber resource, supplies are not unlimited. Present usable supplies of water, like those of timber, can be reduced by mismanagement of the wild lands. Floods waste vast quantities of water. The water resource requires protection and is amenable to management.

As a result of forest-influences research, current fire-protection plans for the national forests give high priority to watersheds even when timber values involved may be negligible. Watershed-management plans have been prepared for a number of national forests. In eastern forests, these plans modify logging practices which would start erosion and reduce water quality. On western forests, watershed condition as well as forage has become a criterion for setting grazing schedules and allotments.

State and municipal forest administrations have benefited from this research. Cost of treating domestic water has been reduced by eliminating practices on the watershed which produced silt. In some cases this meant retiring municipal watershed land that had been rented for farming, a step that more than paid for itself. Other municipalities, learning that proper harvesting practices will not harm their watersheds, are getting income from timber growing on such lands.

Forest-influences research has shed light on the factors contributing to floods, and has devised methods for their control. Flood-control surveys are currently locating and describing flood-source and problem areas, and prescribing flood-control measures for critical watersheds.

While showing that the accelerated erosion that accompanies misuse of the land shortens the life of dams, fills harbors and channels, and causes mud-rock flows, research has also shown that proper land use averts or greatly minimizes these problems.

Finally, forest-influences research has been of immense aid in the development of a public policy of soil and water conservation. It contributed to a public understanding of the land sickness that follows abuse and an awakening to the fact that ownership of the land does not justify its abuse. It led to legislative recognition of the role watersheds play in flood control and a program for combating floods at their source. And increased knowledge of the facts of forest influences is leading to stronger public support for watershed management, which may be one of the most important factors determining the future progress and security of our Nation.

Forest-Economics Research

For a sound program of forestry it is necessary to appraise the financial and social factors that influence the production and use of forest resources. This requires both the collection of basic facts on the status of forest resources, forest industries, and markets for timber products, and the interpretation of such facts in the light of related economic and social conditions. Dealing essentially with values, forest-economics research seeks to weigh the effectiveness of forest policies and practices in terms of net returns to individuals and to communities. Such information provides a basis both for public policies and for private business decisions affecting the management and use of forest resources.

Beginning with early compilations of data on timber resources made under the direction of the United States Commissioner of Agriculture in 1876, general investigations of forest conditions and trends have been made from time to time. Following World War I, several comprehensive appraisals were made. The first of these, the "Capper Report" of 1920, was prepared in response to a Senate resolution introduced by Senator Capper of Kansas, calling for a report on timber depletion, lumber prices, lumber exports, and timber ownership in the United States. In 1933, the Forest Service prepared and sent to the Senate "A National Plan for American Forestry." This monumental report, popularly known as the "Copeland Report," gave the most complete Nation-wide data on the forest situation up to that time, and outlined plans to insure the economic and social benefits that could and should be derived from well-managed forests.

Another comprehensive statement was prepared in 1938-40 for the Joint Congressional Committee on Forestry, which had been established in response to a special message to Congress from President Roosevelt requesting a study of the forest situation in the United States, particularly with reference to privately owned forest lands.

The most recent general study was the forest reappraisal, started in 1945. Several reappraisal reports were issued in 1946 and 1947, including reviews of the status of timber resources and potential future requirements for timber products, studies of the problem of protection against forest insects and diseases and the problem of wood waste, a study of cooperative associations of forest owners, and, for the first time, a field survey of prevailing timber-cutting practices. A general summary and analysis of reappraisal data was published in 1948.

These and a number of other comprehensive reports have provided much of the basic data on which national policy in forestry has been built over the years. They have given an increasingly clearer conception of the character of forest resources and the impacts of sweeping economic changes on these resources. They have also pointed toward the kind of action needed to insure adequate future supplies of timber.

THE FOREST SURVEY.—The McSweeney-McNary Act of 1928 authorized a Nation-wide survey of forest resources—the first complete survey ever undertaken of forest resources and conditions on the Nation's 624,000,000 acres of forest land. Field work was begun in 1930 to

obtain accurate and detailed facts as to the area and location of forest lands, volume and character of timber resources, ownership of forest land and timber, present and potential rates of timber growth, timber drain from cutting and destructive agencies, and potential future requirements for various forest products. Such facts are fundamental to both public and private programs for better forest management. They are basic to plans for long-term development of wood-using industries.

During the 1930's the forest survey covered about 300,000,000 acres, or nearly half the Nation's total forest area, including the important timber-growing regions of the South, the Pacific Northwest, and the Lake States. Following World War II, the survey was resumed at an accelerated rate, and intensive surveys are now in progress in the Northeast, Central States, California, and parts of the Rocky Mountain region. At the same time, areas originally surveyed during the 1930's are being reinventoried to determine the changes that have occurred. Amendments to the McSweeney-McNary Act in 1944 and 1949 provided more adequate authorizations for completion of the survey and for keeping it up to date.

During the past 3 years a total of nearly 100,000,000 acres of forest land was covered for the first time. Including compilation and analysis of data, about 60 percent of the total initial survey of the country's forest resources has now been completed. Resurveys in 1946-48 covered an additional 89,000,000 acres in the field—about 30 percent of the resurvey job currently needed.

Much of the forest survey is being done in cooperation with State agencies, forest industries, and other groups who are making financial and other contributions to speed up and intensify the work. New techniques based upon interpretation of aerial photographs and the use of modern statistical sampling techniques are being used to increase efficiency and lower costs.

An important phase of this Nation-wide survey of forest resources has been the determination of probable future requirements for timber products. Together with basic facts on available resources and prospective timber growth, these investigations provide data needed for determining ways and means of balancing the Nation's timber budget. Detailed investigations have been made to determine lumber requirements for housing, farm construction, mining, shipping, and a number of other purposes. General appraisals of potential requirements for all major timber products were prepared in connection with the forest reappraisal of 1945. During the past year a survey was started to determine the amounts and kind of wood used in manufacture and in the shipping of manufactured products.

RELATED RESOURCE INVESTIGATIONS.—The resource information obtained by the forest survey is of great direct value to local governments, wood-using industries and landowners. It has also contributed to the preparation of special reports dealing with such national questions as the impacts of foreign aid on domestic timber supplies, the availability of domestic timber resources and products in relation to possible military needs, the possibilities for expansion of the domestic newsprint industry, and various other policy questions. Among the

agencies for which such reports have been prepared are congressional committees, the Munitions Board, National Security Resources Board, Council of Economic Advisers, the Department of State, and the President's Committees on Foreign Aid.

Closely related to the forest survey have been numerous local studies of land utilization made in various forest regions by State and Federal agencies. These have appraised such matters as the economic and social effects of forest depletion, problems associated with tax-reverted lands, and competition between forestry and other land uses. During the past year, for example, surveys were made in the fire-damaged areas of Maine to prepare a land-use program for utilization and rehabilitation of fire-damaged timber resources. In the Columbia Valley region a comprehensive analysis of forest resources was recently made to appraise the possibilities of forest-industrial development and power requirements in that region. A report on the anthracite region of Pennsylvania published in 1948 includes an analysis of the problem of employment in relation to forest resources.

OTHER ECONOMIC INVESTIGATIONS.—Studies of forest ownership, now under way in the South, west coast, and Northeast, are seeking to determine the existing pattern of forest-land holdings, factors influencing management of forest properties, and public policies that may induce landowners to improve the management of their forest holdings.

Statistical data on output of forest products have been compiled for many years in cooperation with the Bureau of the Census and other agencies. As part of the drain phase of the forest survey, localized studies are being made in a number of States to determine production of forest commodities and the waste associated therewith. During World War II, Nation-wide reports on lumber output and stocks, production costs for various forest products, and factors affecting production were compiled to provide a factual basis for emergency production, price, and allocation controls. A large number of special studies were made covering such matters as the availability of aircraft spruce, dogwood shuttle blocks, and other strategic war materials. Measures were outlined for meeting wartime needs for timber products. Considerable information also was furnished war agencies through informal advisory service. In the postwar period a number of analyses of the lumber-supply situation also were made to aid in determining policies relating to such matters as housing programs, antiinflation measures, and export availabilities and controls.

Periodic studies have been conducted since 1920 to determine the geographic pattern of lumber markets. For many years data were compiled on stumpage and log prices for privately owned timber.

Following passage of the Research and Marketing Act of 1946, marketing investigations have been seeking ways of solving local problems of marketing farm-forest products through such measures as price and market reporting services, development of quality specifications, centralized marketing organizations, and other measures. The Forest Service has also worked closely with the Otsego Forest Cooperative at Cooperstown, N. Y., to determine the effectiveness of cooperative associations of forest owners in achieving improved forest management and utilization.

The financial aspects of private forestry have long constituted an important field of research. Studies at such locations as the Crossett Experimental Forest are conclusively demonstrating how substantial incomes can be obtained from the frequent partial cutting of managed forests. Investigations have also been made of forest taxation as a factor influencing timber growing and utilization. Early tax studies, summarized in a comprehensive Forest Taxation Inquiry report, focused attention on the fact that remedies for forest tax problems involve sweeping improvements in governmental organization and tax administration, as well as special forest tax legislation. At present, Forest Service activities in this field are confined largely to advisory services to States and local governments on special tax problems.

The requirements for establishing credit facilities to finance long-term forestry enterprises also have been investigated from time to time and principles developed for a federally sponsored forest credit system. Other studies have explored the problem of providing equitable forest fire insurance.

In the somewhat broader field of public-forest economics, investigations in the Northwest and the Southeast have indicated economic guides for determining justifiable expenditures of funds for fire control based on the objective of minimizing fire costs plus fire losses. Recent studies of the economics of blister rust control in the West have provided a basis for practical policies to guide control efforts. In the field of flood control and watershed management, a start has been made on the analysis of economic considerations affecting water policies and programs. A limited number of investigations have touched upon problems in the field of range economics.

FOREIGN FORESTRY INVESTIGATIONS.—Investigations of forest conditions and practices in foreign countries and international trade in forest products have become of increasing importance. In 1923 the first comprehensive report on forest resources of the world was issued. During the second World War information on forest resources in various prospective theaters of military operation were compiled for the military services. More recent studies, prepared for the military services and the State Department, have dealt with policies relating to forests in occupied territories. Since the establishment of the Food and Agriculture Organization, the Forest Service has also assisted in preparing material for its international reports and conferences.

FACTS ARE NEEDED.—Each step in the long process of growing, processing, and marketing forest products is associated with complex economic and social problems. With the task of shifting from a forest economy based upon exploitation of virgin timber resources to one based upon growing new timber crops, difficult questions arise for both public forestry agencies and private business. Economic considerations become more and more important as shortages of timber supply require closer utilization, as competition from other materials affects timber markets and incomes, as patterns of land use change, and as permanent forestry assumes increasing importance in local and national economies. The long-term planning necessary for growing merchantable timber crops introduces special problems not encountered in most other economic activities. In the years ahead, the Forest

Service will continue its efforts to provide needed information on all phases of the broad field of forest economics.

Forest-Products Research

The forest-products research program of the Forest Service aims at making wood give better service, longer life, and greater satisfaction to the user, at lower cost whenever possible. It seeks to reduce waste, to develop an integrated utilization of all the forest crop, and to protect and enhance the markets and values for forest products. To these ends substantial progress is being made.

Research on wood utilization is centered at the Forest Products Laboratory maintained by the Forest Service at Madison, Wis., in cooperation with the University of Wisconsin. When the Laboratory was established in 1910, it was the world's first institution devoted exclusively to the study of forest products. It is still the world's leading institution in its field. Its discoveries have led to the growth of several new industries and have given new life to many old ones. During both World Wars the Laboratory went "all out" on war work, performing valuable services for the Army and Navy and war industries. Recent developments at the Laboratory point the way to many new uses for products of the forests in the years ahead.

Hundreds of people from all over the world come every year to visit "Madison's House of Magic," as the Laboratory has been called. Each year thousands of mail inquiries are answered and wood-utilization problems are discussed with industry representatives who come seeking advice. When a problem is of such scope as to warrant special study, a cooperative research project may be undertaken, subject to advance agreement as to methods and costs. The purpose of such projects is not to promote one product as against any other, but to determine facts which will benefit industry and the public.

During the past few years, the Forest Service has assigned wood-utilization specialists to field stations in several forest regions to help local wood-using industries with technical problems, facilitate adoption of new Laboratory findings, and promote better wood utilization generally.

SEASONING OF WOOD.—The Forest Products Laboratory pioneered the development of lumber dry kilns. More than 5,000 commercial kilns in the United States now employ the internal fan system of controlled drying invented by the Laboratory to season lumber rapidly and safely. These advances have given the United States world leadership in kiln-drying equipment and practices. They have made it possible to market species such as gum and some kinds of oak that previously had sustained such heavy seasoning losses that their utilization had been considered impractical. They have greatly reduced waste and improved the quality of wood products.

There are many uses and circumstances where air drying is still needed. Here again, commercial practice has been greatly improved because of knowledge developed by the Laboratory. Research is being continued on other special wood-drying processes. Among those investigated during the past year were vapor drying, solvent

seasoning, vacuum drying, boiling in oil, superheated steam, infrared radiation, and high-frequency dielectric heating.

GLUES AND GLUING.—Investigations of wood-working glues at the Forest Products Laboratory have markedly improved the serviceability and increased the use of glued wood products. As a result of improvements in the properties of glues, plywood is now successfully used for boat construction, for exterior covering on buildings, for freight cars, truck bodies, and aircraft, and for many other purposes demanding a high degree of resistance to severe service requirements. Of some 2,000,000,000 square feet of plywood now produced each year by the Douglas-fir plywood industry, 500,000,000 square feet are of exterior type suitable for weather exposure—more than the total Douglas-fir plywood output in 1934. Results of the Laboratory's work are even more directly reflected in the scores of plywood specifications and commercial standards in current use.

Improved gluing techniques found extensive use in the production of glued-laminated products during World War II. A manual published last year on the laminating of structural wood products was enthusiastically received by industry.

The work has contributed to the development of a new branch of the woodworking industry—the fabrication of glued-laminated structural members suitable for use in such buildings as factories, schools, churches, auditoriums, gymnasiums, and barns, and more recently for boat, mine, and bridge timbers. Dozens of products formerly made of solid wood are today being laminated from smaller pieces.

Closely allied with research on plywood, glues, and gluing are the studies of veneer cutting. Cutting characteristics of 21 species not previously used for veneer were investigated in an effort to broaden the supply of suitable logs. Several of these are now being used commercially. Laboratory work in this field led to the building of a veneer and plywood plant in Idaho, the first in the intermountain region, and to expanding use of white fir and hemlock for plywood in the Pacific Northwest as the supply of high-quality Douglas-fir decreases.

PRESERVATION AND PROTECTION OF WOOD.—Since its establishment, the Forest Products Laboratory has recognized the need for improving the serviceability of wood exposed to attack by decay fungi, injurious insects, and marine borers. Its studies have had an important part in increasing the usefulness of wood products such as cross ties, poles, posts, lumber, and marine piling, and in reducing the drain on our forests for replacement. Reduction in the average yearly cross-tie replacements by all railroads from 265 per mile in 1915 to 112 in 1947, alone has saved more than \$100,000,000 per year and has reduced the volume of wood needed for cross ties by almost 60 percent.

Work on the technique of painting has made possible many savings. Other studies have developed much information on the use of varnish, wood sealers, and water repellents to stabilize the moisture content and dimensions of wood exposed to fluctuating conditions of dampness and dryness. A systematic study to determine the principles for formulating the best red barn paint was begun during the year with funds provided under the Research and Marketing Act.

Work on fire-retardant treatments for wood has resulted in the development of certain economical, effective formulations which are gaining increasing use.

CONTAINERS.—The container industry in the United States uses vast quantities of lumber, veneer, and pulp products. Research on shipping containers by the Forest Service dates from the earliest days of its existence. A Forest Service circular published in 1906 showed how "increasing scarcity of familiar materials" could be relieved by substituting six other species for scarce white pine. Principles evolved from the early studies have found extensive use both here and abroad in developing containers of greater strength from less material. They have saved manufacturers and shippers millions of dollars through reduction of shipping and breakage losses.

Design data have been developed for crates to carry loads as great as 30,000 pounds. Evolving from the study of large crates during the past year was a new type of prefabricated construction for open crates that requires 30 to 40 percent less lumber than a fully sheathed crate of the same size.

Numerous container-testing techniques have been developed. Many of them are now used throughout the world. One of the testing machines is a huge revolving drum which always attracts the interest of visitors to the Laboratory. Boxes or cartons tested in this drum get more rough treatment than the burliest of freight handlers would ever give them.

Rules and formulas for design are being worked out for fiberboard containers that will be comparable to those previously worked out for other types of containers. A study is under way on the panel type of construction employing wood cleats. Other studies cover blocking, bracing, and cushioning of commodities in containers.

Work on shipping-container problems was the largest single war activity of the Forest Products Laboratory and represented its most spectacular contribution to the war effort. The studies were credited with having greatly reduced damage to war material in transit and with saving at least 10 percent in lumber requirements and 20 percent in shipping-space requirements. This meant that 4 ships could carry as much war material as five had been able to carry with earlier methods of packaging.

CHEMISTRY AND CHEMICAL CONVERSION.—An impressive array of products, many of them indispensable to modern living, comes from the chemical processing of wood. Chief among these are cellulose products—paper, rayon, and cellophane—because wood offers cellulose in concentrated, easily removable form, and therefore is the most economical source of it. Lignin, the other chief chemical constituent of wood, has, on the other hand, found little practical use thus far and is now largely wasted, although it constitutes about 30 percent of the wood substance in trees.

The Forest Products Laboratory has carried on extensive research in virtually every branch of chemical conversion, and has pioneered in many applications. Fundamental to all such advances has been its research in the chemistry of wood itself. Since 1925 it has carried on a program of fundamental research that has yielded a vast

amount of information on the interfiber communicating capillary structure which is below microscopic visibility; the extent of the internal surface of wood that takes up water (amounting to about one-half acre per cubic inch of wood); the forces of attraction of wood for water (about twice those of water for itself); the nature and forces of swelling; and the dispersion and molecular shape and weight of cellulose and lignin.

An example of the use of this fundamental information is the development of applied methods of stabilizing the dimensions of wood. The Laboratory showed that shrinking could be greatly curtailed by introducing bulking agents, such as resins, into the fiber walls and bonding them to the wood. The outcome of this research has been resin-impregnated wood, called "impreg," and a compressed form of this product called "compreg." The unusual properties of these modified woods have brought them into new fields of use ranging from table tops and ship decking to molds and dies for metal working.

The Laboratory pioneered in the conversion of wood to ethyl alcohol during World War I, collaborating in the development of the so-called American process of hydrolysis. During World War II, the basic product of hydrolysis, wood sugar, was utilized both in alcohol research experiments and in production of wood-sugar stock-feed molasses. The Madison wood-sugar process has been the outcome of this research and offers promise of converting great quantities of waste wood to molasses. Feeding tests under way during the past 2 years at a number of agricultural experiment stations and universities have shown wood molasses to be acceptable high-energy stock feed for dairy and beef cattle, hogs, sheep, and poultry. Wood sugars have been transformed into another type of feed, a yeast, that is also being tested with poultry. Yeast fermentation on these sugars has been developed into a continuous process.

For many years the Laboratory has pursued research into the chemical nature of lignin, with the ultimate objective of broadening its usefulness and thereby curtailing its waste. Many products, including alcohols, methanol, phenolics for use in plastics, and various neutral oils suitable for use as solvents, have been obtained by hydrogenation and pyrolysis. Some of the products obtained are as yet unidentified. Research has produced some sheet materials of lignin that have plastic properties, and a few lignin derivatives have found limited commercial use. On the whole, however, large-scale use of this byproduct remains in the future, dependent upon further research.

PULP AND PAPER.—Need for extending the range of species used for the manufacture of wood pulp was recognized long ago. It was clearly indicated that spruce, fir, and hemlock could not continue to meet our expanding pulpwood requirements. Accordingly the Forest Service undertook a systematic study of the suitability of more than 100 American woods for production of wood pulp. Outstanding in this early work was the production of good kraft pulp from the southern pines and from jack pine. After the first sulfate pulp mill was established in the South, close contact was maintained with that growing industry to determine the course of future research. Improved processes were developed for bleaching sulfate pulp. Pro-

duction of sulfate pulp in the South doubled every 5 years until the depression years and increased enormously thereafter. Following investigations at the Laboratory, the successful use of Douglas-fir and other woods for sulfate pulp has developed within the past few years.

The work on southern pine included investigations on the production of newsprint paper. Tests on numerous combinations of pine and hardwood pulps indicated that several compositions were possible. The one recommended as most practical under existing conditions is now being used in commercial production.

During this early work, it became apparent that the then conventional methods would not be suitable for successful use of some species and new processes would have to be worked out. This led to the Laboratory's development of semichemical processes, a combination of chemical and mechanical pulping. A specific method, called the neutral sulfite semichemical process, was found to have wide application and was especially suitable for pulping hardwoods. Recent commercial applications have been for high-quality corrugating board from a number of hardwoods, unbleached and bleached butcher's wrapping paper, and book and magazine papers. Laboratory demonstrations have shown that hardwood neutral sulfite semichemical pulp can be used in making newsprint paper. Other applications are in the course of commercial development. Semichemical pulp production is increasing and this process is a promising one for extensive and economical utilization of low-value hardwoods.

Ground-wood pulp is an important paper-making material because it is obtained in high yield at comparatively low cost. Its use in printing paper has been limited to one or two of the lighter-colored softwoods. Laboratory experiments have led to recent commercial developments in the bleaching of ground-wood pulps which should expand the variety of woods that can be used. The Laboratory also has discovered that a number of northern and southern hardwoods have definite possibilities for ground-wood pulping for many of the kinds of paper in which softwood is now used. In parts of the United States where most of the ground-wood industry is located, supplies of the more favored softwoods are becoming inadequate to meet present high demands but large quantities of hardwoods are available.

HARVESTING THE TIMBER CROP.—Research conducted by the Forest Products Laboratory at commercial logging and milling operations in cooperation with the regional forest experiment stations provided figures on lumber production costs and returns that gave forest managers a definite dollars-and-cents basis for putting selective logging practices into effect. The figures showed that it often does not pay to cut small trees—that the labor and processing costs in cutting trees before they reach certain sizes may be greater per thousand board feet than the value of the wood cut.

Extensive research on the grading of hardwood logs culminated in a system of log grading applicable to all hardwood species cut into standard lumber. In 1948 these log grades were disseminated to the industry and received substantial endorsement. They meet a need on the part of managers of timber properties and buyers and sellers of logs for a method of accurately determining the money values of hardwood logs.

The Laboratory has long had an active research program under way to aid farmers in the harvesting of their timber and the thousands of small sawmill operators now responsible for a substantial portion of our total lumber production. This research has assisted greatly in improving mill equipment, reducing miscuts and waste, lowering handling costs of timber, and numerous other phases of operation.

WOOD AS AN ENGINEERING MATERIAL.—Wood was among the first materials of construction in early civilization. It maintains an indispensable place in modern engineering. Not only is wood an essential engineering material in normal times, but it is regarded as one of the most important and critical materials used in modern military operations.

It is axiomatic that efficient engineering design with wood depends on an intimate knowledge of its mechanical properties and the factors that influence these properties. Consequently early research included the establishment of a standardized system of conducting strength tests, and studies to obtain data on the strength and related properties of the various species. Systematic, comparable data have been obtained on some one hundred and seventy-five American woods.

Grading rules developed by the Laboratory for structural timber have been incorporated in the official American Lumber Standards promulgated by the United States Department of Commerce, and serve as a basis for classification of all such timbers within the industry. Estimated savings from these basic studies are several million dollars a year.

Another important field of research has to do with joints and fastenings, which are usually the weakest part of any timber structure. Mechanical tests with bolt and nail and similar types of fastenings have provided basic data for engineering design. More recently the development of metal connectors, in which the forest industries and the Laboratory participated, has provided a means for still further improving the strength of joints and fastenings. Metal connectors have accounted for additional markets for timber running into many millions of board feet annually.

Engineering studies on the strength and rigidity of frame walls emphasized the importance of diagonal bracing. The results have been incorporated in the code requirements covering much of the small-building construction in the United States.

A comparatively recent development is the previously mentioned use of laminated members of straight or curved form made by bonding boards with water-resistant glue. Laminated arch construction permits high ceilings with large clear spans and unobstructed floor area. Unique architectural effects, excellent strength, and unusual fire resistance are qualities that presage extensive use. By facilitating construction of large structural members from smaller pieces, this development is significant now that an increasing proportion of our lumber must come from the smaller, second-growth trees.

WOOD STRUCTURE IN RELATION TO USES.—Knowledge of the structural components of wood, their arrangement, and behavior under changing conditions, finds application in a multitude of ways.

The Forest Products Laboratory has found, for example, that strong Southern pine timber cannot be produced unless the trees have sufficient soil moisture during summer to produce adequate amounts of summerwood. It follows that to try to produce dense wood on dry sandy soil is useless. On the other hand, certain species growing in too wet situations produce swelled butts with light, spongy wood that has undesirable properties. Hickory, ash, and other hardwoods must maintain a good rate of growth throughout their life if they are to produce strong wood all the way out to the bark. Open-grown sugar maple was found to be much denser than forest-grown; the density is similar to that of dogwood, for which it makes a satisfactory substitute for shuttle blocks.

Wood from different trees of the same species may vary greatly in texture, toughness, and density. Knowledge of such variations is important in the selection of a particular wood for a given use. Abnormal structural features may cause trouble—for example, the so-called compression wood of conifers that develops on the underside of leaning trees. Compression wood is subject to excessive lengthwise shrinking that causes warping; it is brittle and its extreme hardness makes nail driving difficult. Conditions favoring development of compression wood and methods for its easy detection have been studied.

Laboratory studies have shown that broad structural features, such as percentage of summerwood, or density, may be used in selecting lumber for certain high strength requirements. These and related findings have led to a start toward managing forests so that the proportion of elements influencing density can be controlled or modified, thus regulating the strength of wood as it grows.

WORK AHEAD.—Despite the great strides made in wood utilization, there is still need for more complete utilization of wood waste and low-grade material. There is need for further improvements in the utilization of unpopular species. Wood in natural or improved forms can be made to serve the user still better. Future possibilities in the chemical conversion of wood are almost unlimited. The program for the Forest Products Laboratory calls for intensified work on utilization of wood waste and low-grade materials; further improvements and economies in structural utilization of wood; development of new preservatives and treating methods; improvements in and simplification of gluing techniques; increasing the fire safety of wood; improvements in paint technology; development of new or improved paper products; chemical conversion of wood; and other studies aimed at expanding the uses of wood and making it give better service. Work on lignin especially should be stressed. There is much work to be done on the properties and characteristics of tropical woods as a basis for determining their usefulness to the United States.

Tropical-Forest Research

Tropical-forest research began with the establishment in 1939 of the Tropical Forest Experiment Station in Puerto Rico, under authorization of the McSweeney-McNary Act. In 1943 the Tropical Station was combined administratively with the Caribbean National

Forest, the joint office now constituting the Tropical Region of the Forest Service. The Director of the Tropical Region also administers the Insular Forest Service of the Puerto Rico Department of Agriculture and Commerce.

Puerto Rico's forests cover about one-fourth of her total area. They are low in productivity as a result of continuous culling. Forest destruction has brought wood scarcity to the dense population of the island and has lowered the quality of water for irrigation, power, and domestic use. The results of research at the Tropical Station are of direct applicability in the 32,000-acre Caribbean National Forest, on some 44,000 acres of Insular Forests, and on an additional 600,000 acres of private lands that should be dedicated to forest growing. The productivity of these lands is the basis for an existing forest industry which for fuel wood and charcoal alone yields \$15,000,000 annually.

The research program in Puerto Rico is important also to the entire Caribbean Region, which includes the West Indies and the Atlantic slope of central and northern South America. This area, with more than 380,000,000 acres, of which about 260,000,000 are forest land, is similar in character to Puerto Rico. Accessible forest lands have all been subject to abuse. Knowledge is generally inadequate to make possible good forest management and almost no other forest research is in progress. Numerous Caribbean countries have made contributions to the station and the number of requests for forestry information and assistance in forestry training is increasing.

Investigations in Puerto Rico are confronted with numerous complexities. Within a few miles the annual rainfall varies from 25 to 180 inches. Soils are equally variable. The forests are generally complex as to composition; stands of 50 or more different tree species per acre are common, and more than 500 species are native to the island. Tree growth and stand increment cannot be determined without time-consuming periodic remeasurement of individual trees, since growth rings are absent from the wood or are of unknown periodicity.

PROGRESS IN RESEARCH.—Tropical research began with the collection and analysis of available information on the extent and nature of the forests and forest lands of the island. The second step has been the testing, adaptation, or development of techniques of reforestation and silviculture. Field experiments are in progress in three experimental forests, both divisions of the Caribbean National Forest, and eight Insular Forests.

Region-wide dissemination of the findings of research is provided through *The Caribbean Forester*, a quarterly journal published by the station in Spanish and English, with summaries in French. The British possessions in and near the Caribbean Region bear part of the cost. To date *The Caribbean Forester* has made available 180 technical articles, contributed by members of the station staff and others in the Caribbean Region.

The station has participated in all important regional conferences on forestry or in allied fields. Staff members took part in surveys of the forests of Costa Rica and Ecuador. The Director presented the recommendations of the station for the development of tropical for-

estry before the Inter-American Conference on the Conservation of Renewable Natural Resources at Denver in 1948.

Research at the Tropical Station has produced a number of findings of significance to Puerto Rican forestry. It has made possible quick appraisal of relative tree-growth rates as a guide in cutting. Satisfactory propagation techniques have been discovered for 48 tree species of present or potential importance. Successful direct seeding of Dominican mahogany has reduced by 50 percent the planting costs of one of the most valuable species of the region. The possibilities of wood-lot forestry are seen in coppice stands of pomarosa which produce from 20 to 25 cords of posts and fuel wood per acre on an 8-year rotation. Rules have been prepared for forest improvement based upon growth records and the appraisal of about 240 tree species, classified according to the value of their wood, size at maturity, form, growth rate, reproductive ability, and freedom from disease and pests.

During the past year investigations were concentrated on the management of rain forest, the most prominent type in the Caribbean National Forest and in three Insular Forests. An experimental timber survey showed the practicability of strip cruising. A merchantable-height volume table, the first of its type in the region, was prepared for interpretation of timber cruises and sample-plot data in the public forests and in an island-wide forest survey being conducted by the Insular Forest Service.

LOOKING AHEAD.—Research in tropical forestry is only now getting well under way. Further research is planned on methods of improving existing forests. Studies of underplanting, a practice which promises rapid improvement in forest composition, have just begun. Thorough investigation will be needed to determine more accurately the optimum forest density and composition for maximum quantity and quality growth. The station hopes to make a study of private forest plantings throughout the island as a basis for specific recommendations regarding private forestry. Intercultivation of farm crops with young forest plantings as a method of weeding should be thoroughly tested, for it may make private reforestation much more attractive.

Many other jobs lie ahead in tropical forest research. Development of satisfactory and cheap preservative treatment of fence posts and construction woods, for example, will reduce the cost to consumers and help to relieve the forest from excessive cutting. Soil stability and water yield of rain forest is a problem of prime importance throughout the region. Wood utilities of only a few species are well known. Further studies in this field will not only increase the value of the forests but will make possible judicious selection of individual trees to be favored in silvicultural practice.

THE RESEARCH PROGRAM FOR THE FUTURE

We still have much to learn in forestry. Some of the many problems yet unsolved have already been mentioned in earlier sections of this report. In all fields of forestry, as in everything else, ways can often be found for further improvement of present practices—for doing things even better and faster and at less cost.

One of the main tasks in forest-management research will be to test many recent findings in the practical money-making business of timber growing. Research recommendations cannot be refined and made fully reliable until this final, pilot-plant work is done.

Forest pests—insects and diseases—still plague the timber grower constantly. New pests keep cropping up. We do not yet have forest fires licked. There are still numerous problems to be met in range restoration and range use. As the multiple use of forests grows, there is more to be learned about how to produce the kinds of forests that will be most efficient for watershed protection, for game use, for recreation—and in some cases how to make these uses more compatible with timber production and range grazing.

In its research program for the years ahead, the Forest Service hopes to do serious and continuing work in fundamentals of tree and range plant physiology and forest ecology, and genetics. Thorough groundwork in these basic sciences will speed the advance to new, practical applications.

There is great need for more forest research in Alaska. The new research center established last year at Juneau is getting under way with studies on forestry problems in the Southeastern Alaska panhandle. The potentialities of the more northern coastal forests and of the vast interior forests are yet to be explored. It is hoped that work in these areas can be developed under a full-fledged regional forest and range experiment station for Alaska, as authorized by the McSweeney-McNary Act.

It is hoped, too, that a forest and range experiment station for the Great Plains, authorized but not yet financed, can be established. The Plains States contain millions of acres of range lands of great importance to the economy of the region, for which little research has ever been provided. They also contain more than 3,000,000 acres of commercial forest lands, mostly in farm ownership; and some thirty-two million acres of other forest lands, such as the oak-cedar breaks of Oklahoma and Texas, which have so far received little attention. More studies of windbreak and shelter-belt planting also are needed—to find the best kinds of trees, the best locations for them, and better and cheaper methods of establishing them and keeping them growing for shelter-belt purposes.

The Forest Service will continue the development of research centers and experimental forests and ranges under the existing regional forest experiment stations. Cooperative relations with other research agencies and private enterprises will be maintained. Some additional research centers are needed. The facilities at many of the existing centers need strengthening. Forest utilization service should be extended to areas not yet covered. Facilities for pilot-plant studies are a special need.

Effective research requires competent research workers. The Forest Service has always been quite "choosy" in its selection of research personnel. It will continue its exacting requirements. From time to time, research men—especially the younger ones—may be assigned to administrative work on the national forests or to cooperative work with the States and with private owners. Administrative personnel

in turn are sometimes assigned to research jobs. Such interchange of personnel helps to broaden the men's experience, and to keep research workers in close touch with the practical considerations involved in their work.

On-the-job training is provided for research personnel, similar to that of other employees, but in many ways more intensive. Efforts are continually being made to improve and intensify the personnel training and development work. The Forest Service encourages its research men who have not already had advanced schooling to go back to school, if possible, for graduate work in their special fields. It would like to do more of this; perhaps authorization for a small-scale system of educational aid would make it possible for more young research foresters to get desirable advanced schooling. Provisions for foreign study would also be desirable for certain specialized fields of work.

To hold up its end in a progressing nation, forestry must also progress, have vision, keep up with changing conditions. Forestry is still a relatively new science in America. Many practices recently developed through research have not yet been used long enough to fully prove their worth. Much knowledge has not yet been applied at all.

But research cannot sit back and wait until practice catches up with knowledge—until all of its findings are universally applied. It must keep ahead of the game. It must anticipate future needs. It must keep young in spirit, adventure, and ideals.

Backed by ever-increasing knowledge, soundly applied, forestry will go steadily forward. Its potentialities for contributing to national prosperity, security, and progress are enormous.

The need for Federal leadership in forest research is inescapable. Many forest and range problems are national or regional in import. They do not follow State boundaries. Nor do they all fall into handy compartments representing individual industries or operations.

To be effective and to the point, research must be closely coordinated with the work of those having action responsibilities, both in public and private enterprises—with those who will translate research results into business activities or management practices on the ground. Yet it must be sufficiently independent so that research integrity cannot be challenged.

Through years of experience, the Forest Service has developed what it believes to be a desirable balance between coordination and independence in its research program. Its research staff maintains close contact with industry, with public and private land managers, with other public agencies, and with other research institutions. Its regional experiment station set-up keeps it in touch with local problems; and the headquarters research divisions endeavor to provide the necessary integration and coordination. At the same time its workers are encouraged to do their own thinking and to exercise initiative. They are under no obligation to any special groups or interests. The ultimate criterion in determining the direction of the research program is the public interest.

Research contributes to basic knowledge essential for the formulation of sound national forestry policy. It does not itself formulate policy. That is the responsibility of the administration and the Congress. Through forward-looking research, the Forest Service is endeavoring to help point the way.

NEW KNOWLEDGE MUST BE APPLIED

To find the right answer to a problem is only part of the job. The problem will be met only when the new knowledge is put into practice. The results of research, therefore, must be brought out of the textbooks and technical reports and applied on the ground.

Our forestry knowledge is not yet widely practiced. The recent reappraisal of the forest situation showed that only 23 percent of this country's total operating commercial forest land is being managed under cutting practices that rate good or better from the standpoint of keeping the forest in productive condition. A high proportion of this is national forest and other public forest lands. But three-fourths of our commercial forest land is in private ownership. On private forest lands only 8 percent of all cutting practice is in accordance with good management principles. Twenty-eight percent rates fair; 64 percent is poor or destructive. This factual statement is made with full recognition and commendation for the private owners who are practicing good forestry.

The annual drain of saw timber from the forests still exceeds the rate of growth. Furthermore, much of the drain is of high-quality old-growth timber, and especially of the more valuable softwoods needed for construction lumber, plywood, and other important uses; whereas much of the growth is of inferior kinds of hardwoods and other poor-quality material. The general quality of our timber growth is steadily deteriorating. Research is finding ways to put some of the low-quality trees to good use; but even so we certainly do not want to devote forest land to growing poor timber when much of it is capable of growing good timber.

Similar problems of inadequate production and deterioration are found on much of the country's range land.

A substantial citizenry tomorrow depends on having a vigorous younger generation today. A commercial forest will have no mature timber a few years hence if younger growth is not kept coming along to replace the timber that is cut. To sustain timber production, therefore, we must have an ample growing stock, with various age classes of timber coming along in a steady succession. In the eastern half of the country, the timber growing stock today is not sufficient to sustain the present cut for many more years. Nation-wide, it is short of what we shall need to sustain an abundant future production for a growing population and an expanding economy.

To stop the downward trend of forest and range resources and to get our forests and ranges on the way to permanent, abundant production, the Forest Service has for many years proposed a more aggressive forest conservation program, with action along three main lines.

First, it recommends continued and intensified public aid to private forest-land owners. Research is an important and essential part of this aid. It should go forward vigorously, both to find answers to the immediate problems of forest and range managers and users of forest products, and to expand our fundamental knowledge as a basis for new advances in forestry.

At the same time, educational and demonstrational work should be continued and expanded, to bring technical forestry know-how to forest owners—especially to farmers and other owners of small forest properties, whose holdings in the aggregate include much of the Nation's most accessible and most productive forest land. The Forest Service and State forestry agencies are cooperating in a program of on-the-ground technical assistance to farm woodland owners. It is highly successful in bringing about improved practices, but it is as yet reaching only a small part of the forest owners who desire such aid, even within the relatively few counties served.

The Forest Service and the States also cooperate in providing organized fire protection for private forest lands, and in production and distribution of trees for planting on farm lands. These activities are reviewed later in this report. They need to be further broadened and strengthened.

Other recommended public aids and services include a federally sponsored forest credit system to make long-term loans to forest owners on terms and conditions suitable for forestry purposes; a federally sponsored insurance system to reduce the risks in forestry enterprises; encouragement of cooperative management and marketing associations of small forest owners; and strengthening of cooperative protection against forest insects and diseases. Improvements in the forest tax laws of some of the State and local governments, and in their administration, would also help to encourage private timber growing.

The second proposal is for public regulation of timber cutting and related forest practices. Educational work and other cooperative measures have induced many forest owners to adopt good practices. But not enough of them. The forest situation has continued to deteriorate, and the trend is still downward. The time has come for more decisive action.

Some fourteen States have enacted legislation looking toward forest regulation. Their regulatory laws vary greatly in effectiveness and administration. The plan that the Forest Service has proposed looks to the establishment of basic, Nation-wide standards through Federal law, and Federal financial assistance to all States which enact and administer regulatory laws consistent with the basic standards. It also provides for Federal administration in States which request it, or which, after a reasonable time, fail to put such regulation into effect.

Regulatory measures and cooperative aids will complement each other. By providing certain basic rules, regulation should stop further forest destruction and deterioration and so help to maintain a reasonable growing stock as a basis for future timber production. Continued education and other cooperative services should help forest owners go beyond the minimum requirements of regulation, improve their forests, and practice real sustained-yield management.

A third line of action has to do with strengthening the public forests. Some thirty-five million acres of the private lands within the boundaries of existing national forests should be acquired through Federal purchase or land exchange. Considerable acreages, especially of badly depleted lands that are unlikely to be restored to productive condition by private owners, should be added to the national forests. The public interest dictates that certain critical watershed areas also be brought into public ownership.

Development and intensified management of the national forests should be pushed. More intensive timber management is needed, with many miles of new access-road construction, and reforestation of some three and one-fourth million acres of partly or wholly denuded timberland. Certain unsatisfactory range situations should be cleared up, and extensive areas reseeded. Watershed values should be further safeguarded or improved. Fire protection should be intensified. Also, to realize the full values of these forests, recreational facilities should be expanded and wildlife management stepped up.

State and community forests should be similarly expanded and developed.

We have plenty of good forest *land* in the United States. But if we are to realize in full measure the values and services of that land we must see that it is well handled and managed for permanent production.

COOPERATION IN STATE AND PRIVATE FORESTRY

Seventy-six percent of the Nation's commercial forest land is in private ownership. The demands of our peacetime economy and the need for security in the event of national emergencies challenge the efforts of every owner to make and keep his forest land productive.

The more formidable obstacles in private forestry center on the forest lands in small holdings. Divided among more than 4,000,000 owners, these forest properties make up about three-fourths of the private commercial forest land. Their large number and small size, the variable aims and skills with which they are handled, and the unstable ownership and management of many—those are the knotty factors which long have blocked efforts to get forest conservation into more general practice.

About 139,000,000 acres of commercial farm woodlands are owned by some three and one-fourth million farmers. Another 122,000,000 acres of small holdings are in the hands of small-town businessmen, nonresident city dwellers, and others. These small woodlands average 62 acres each. They make up much of the potentially most productive forest land in the Nation. Since they have had worse use in most cases than any other part of our forest land, they now require special attention.

The Forest Service is cooperating with State forestry agencies in several programs aimed at providing systematic fire protection, encouraging reforestation, and stimulating better management for forest lands in private ownership, especially those in small holdings.

Farm-Forestry Extension

Educational work in farm forestry is one of the jobs that the State extension services of the land grant colleges are carrying on in cooperation with State forestry departments, experiment stations, and other agencies. This work is administered through the Federal Extension Service of the Department of Agriculture, with the cooperation of the Forest Service as the subject-matter agency. The 65 extension foresters heading up farm-forestry extension develop State-wide educational programs and channel much of their work through county agricultural agents.

Extension work in forestry embraces a broad program of information for farm owners on woodland-management practices, fire protection, tree planting on idle farm lands, and establishing windbreaks and shelter belts. Demonstrating the techniques involved in these and other forestry operations is a part of the forestry educational program. Tours, meetings, radio talks, exhibits, and pamphlets are used to acquaint farmers with forestry information and to stimulate interest in sound management practices.

Extension agents are giving an increasing amount of effort to assisting farmers with the utilization of farm-grown timber for repairs and new construction, and with the treating of lumber and fence posts with preservative to increase durability.

Forestry work with 4-H groups is making substantial progress. Individual and group projects, contests, forestry camps, and other activities help to build interest on the part of farm youth. Forestry training during the year was given to 137,000 4-H Club members; 23,000 were assisted in the techniques of forestry projects on the farms. As the young people gain more knowledge of forestry, and as they assume local leadership in years to come, forestry on the farms should move forward at a faster pace.

In addition to creating an appreciation of the value of farm timber as a crop and demonstrating good practices to individuals and groups, extension agents assist farmers in organizing for community action to provide better fire protection, and to promote better understanding of other forestry problems and how to solve them. Extension agents have enlisted approximately 23,000 local leaders to assist in promoting forestry in their respective communities. Responding to the combined efforts of local leaders, county agents, and forestry specialists, many thousands of farmers last year conducted such forestry activities as planting, thinning, weeding, pruning, selective cutting, and improved practices in naval stores and maple syrup production. Information on timber estimating and marketing has been sought by many farm woodland owners.

Forest-Management Assistance to Woodland Owners

Direct on-the-ground technical assistance in forest management is provided under authorization of the Norris-Doxey Act of 1937. Approximately 180 Norris-Doxey project farm foresters are now employed by 39 cooperating States. These local farm foresters are giv-

ing technical service to individual small owners in about 800 counties.

The forester works with the owner or his representative in arriving at a prescription for the proper management of the specific woodland area. A simple management plan is drawn up; advice and assistance is given in the marking of trees ready for harvest, and some guidance in marketing the products. In numerous instances the job is of sufficient size or the woodland owner's interest is stimulated to a point where he will pay for the services of a private consulting forester to take over where the project forester must stop.

As a result of the Norris-Doxey project work, improved management practices were applied to 1,769,240 acres of small woodlands by 17,140 individual owners in fiscal year 1949. Some four hundred and thirty-eight million board feet of saw timber and other timber products were harvested. Sales of harvested products brought in over $7\frac{3}{4}$ million dollars cash to the owners. Harvested products included 2,198 barrels of gum for naval stores and 158,660 gallons of maple syrup, also Christmas trees, holly, and other miscellaneous products.

At the close of the fiscal year, requests for assistance from 3,121 woodland owners remained unfilled because of the heavy demands on the farm foresters' available time.

As in past years, technical foresters from the regional offices of the Forest Service or from cooperating State forester's offices furnished some assistance to owners of industrial or other large timber holdings. Much of the work of these specialists, however, was with private foresters, either those employed by the large owners or in the consulting field, on new forestry procedures and standards.

Naval Stores Conservation Program

For the fourteenth consecutive year, the Forest Service administered the Naval Stores Conservation Program—a part of the general agricultural conservation program authorized by the Soil Conservation and Domestic Allotment Act.

Conservation payments are made to turpentine producers who carry out approved forest practices. The program operates throughout the naval stores region, which comprises about 50,000,000 acres of forest land in the Southeast. Practices required under the program include the working of proper-sized trees, selective cupping, fire protection, and good cutting practices. The program also promotes use of chemical stimulants to prolong gum flow from turpentine faces.

The Naval Stores Conservation Program has been quite effective in encouraging timberland owners and turpentine farmers to raise larger trees and more trees per acre throughout the Southeastern States. In 1936 the forest survey showed that the average number of turpentine faces per acre for the naval stores region was just under 16. Of these 16 faces, about 25 percent were on trees less than 9 inches in diameter. The conservation program records for 1947 showed that the average number of faces per acre was slightly more than 27, and it was estimated that not more than 2 percent of these faces were on trees less than 9 inches in diameter.

Cooperative Tree Distribution to Farmers

There was a notable increase of forest-tree planting on farm lands during the past year. The supply of tree planting stock from State nurseries was nearly double that of the previous year. More than 77,000,000 trees were distributed at low prices to farmers by the 41 States and 2 Territories (Puerto Rico and Hawaii) which operated under the cooperative tree distribution program of the Clarke-McNary and Norris-Doxey Acts. The area reported planted on farms under this program was 85,000 acres.

The States have for several years been expanding their nursery output in an effort to satisfy the rising demand for forest-tree planting stock. The trend is expected to continue, for many States are still unable to fill all orders.

Cooperative Fire Control on State and Private Forest Lands

The year 1949 marked the twenty-fifth anniversary of Federal-State cooperation in the protection of State and privately owned forest lands from fire under provisions of the Clarke-McNary Act. Cooperative fire protection actually began in 1911 under the Weeks law, but was limited to the forested watersheds of navigable streams. The Clarke-McNary Act of 1924 broadened the scope of cooperation to include all forest or potential forest-producing lands in non-Federal ownership. It was amended in 1925 to include certain non-timber-producing watershed lands from which water is obtained for domestic use or irrigation.

The cooperative program has now been extended to 43 States and Hawaii. Administered by the various State forestry departments, it is now organized on 339,500,000 of the 439,000,000 acres of non-Federal forest and watershed lands that need such protection. During 1948 approximately 11,500,000 acres were added to the area under protection.

But there still remain 99,500,000 acres of potentially valuable forest and watershed lands that as yet receive no organized protection from fire. On much of the protected area, fire control needs to be strengthened by more equipment and additional trained men if fire losses are to be kept within reasonable limits.

For fiscal year 1949, the Congress voted a \$9,000,000 Federal appropriation for cooperative fire control, which was the ceiling of the legislative authorization. This was the second fiscal year in which the full authorization had been made available. Cooperating States supplied \$17,046,000 of State and private funds in 1948, an increase of 28 percent over similar expenditures during the previous calendar year.

The Clarke-McNary Act authorizes a 50-percent Federal sharing of the total cost of protecting State and private lands. Federal appropriations, however, have never been sufficient for the Federal Government to meet its full share of the protection job in any fiscal year since passage of the act. In 1948 State and private sources provided 65 percent and the Federal Government 35 percent of total moneys expended.

The \$9,000,000 Federal authorization was based on a 1938 estimate of \$18,000,000 as the total amount needed. In 1945 joint studies made by State foresters and the Forest Service showed that it would cost \$32,000,000 annually to provide a basic level of protection to the 439,000,000 acres needing protection. Sample checks on the increased cost of equipment and supplies, salaries, wages, and other fire-control items since 1945 indicate that the protection job will now cost at least \$40,000,000. To meet the Federal Government's share, Congress in 1949 provided for raising the Clarke-McNary Act authorization by progressive steps to \$20,000,000 for fiscal year 1956.

Calendar year 1948 is the latest year for which complete fire records of the Clarke-McNary fire-control project are as yet available. On the protected area of 339,500,000 acres, fires were held to 1,961,644 acres, or slightly under six-tenths of 1 percent. Despite an increase of over 11,000,000 acres in the area protected, the area burned was held to 852,737 acres less than the preceding year. The number of fires on protected lands was 61,095, a reduction of 10,347 from those reported in 1947.

The number of fires, acreage burned, and damage on the lands still unprotected can only be guessed at. The estimates of State men most familiar with the areas concerned are that 106,413 fires burned 14,283,000 acres or 14.35 percent of the total area. This would be 25 times the relative burn on areas that have organized fire control.

Tangible damages from fire were reported as \$29,828,651, of which \$6,126,888 occurred on the protected areas. These figures are conservative; individual reports often fail to include all tangible losses. Indirect losses, such as soil deterioration, erosion, destruction of game habitat, irregular stream flow, decay of fire-damaged timber, replacement of desirable tree species by less desirable ones, interruption of tourist use, and other intangibles are not included in the damage figures.

Since the close of World War II, cooperating States have added 36,500,000 acres to the area receiving organized protection. This is encouraging progress, but from the standpoint of national security alone there is need to extend fire control as rapidly as possible to the remaining 99,500,000 acres of unprotected private forest lands. Complete protection coverage against wildfire is a first-priority job if these lands are to produce the needed forest products and other benefits of which they are capable. Of nearly equal importance is strengthening the protection effort on other areas where manpower and equipment are now inadequate to hold fire losses to an acceptable minimum.

THE NATIONAL FORESTS

Returns Greatly Exceed Costs

During the past 2 years, the Forest Service has been carrying on a financial-management study of the national-forest system. The study included a follow-up on previous work started in 1938 on the development of an investment budget for the national forests. These budget studies to a large degree have had the same type of approach as the

recommendations of the Commission on Organization of the Executive Branch of the Government (the "Hoover Commission") in its report on the Budget.

Many of the services and benefits from national-forest management bring no direct revenue to the Government, although they represent substantial values to the public. However, an appraisal was made of the money value of certain of the nonmonetary returns from the recreation, wildlife, and water resources. The financial-management study shows that these evaluated returns plus direct cash receipts to the Government are now in excess of \$400,000,000 a year. Annual costs and returns, in round figures, are as follows:

Nonmonetary returns, evaluated:

Recreation and wildlife-----	\$25, 000, 000
Water-----	300, 000, 000
Free permits for timber, range, etc-----	1, 000, 000
Cash receipts to the Treasury-----	32, 000, 000
Other monetary returns-----	4, 000, 000
Increase in net growth and inventory revaluation-----	50, 000, 000
 Total annual returns-----	 412, 000, 000
Total annual operating costs-----	58, 000, 000

These costs, in addition to including all appropriations for operating expenses, include a depreciation charge on roads and other improvements, interest on investments, and payments to the States of 25 percent of all receipts.

The national forests include large areas that yield no direct cash returns to the Treasury. Ninety percent of the cash receipts come from less than half of their area. The non-revenue-producing areas, however, must also be managed and protected against fire and other destructive agencies, because of their great value as watersheds and for other public service purposes. Consequently a comparison of net cash receipts and gross expenditures does not tell the whole story. A comparison of over-all returns and costs gives a truer picture.

Nevertheless, in fiscal year 1949, cash receipts exceeded the total protection and management appropriation by several million dollars. The "National Forest Protection and Management" appropriation, which includes all normal operating expenses but does not include certain related appropriations such as "Fire Fighting," "Pest Control," "Forest Road Development," and "Flood Control," was \$26,759,775. Cash receipts were just under \$32,000,000.

Perhaps the most valuable returns from the national forests, however, are intangible, not subject to evaluation on a balance sheet. It would be difficult to place a dollars-and-cents value on the community stability resulting from national-forest resource management, on the health-giving enjoyment experienced by millions who vacation in the forests, or on the forests' esthetic and inspirational values.

In connection with the financial-management study, national-forest protection, management, and development for a 5-year base period (1927-31) was compared with the recent 1942-47 period. Between these two periods, a great many improvements and additions to national-forest protection and administration facilities were made through the work of the Civilian Conservation Corps and other public-

works programs of the 1930's. These improvements have paid big dividends. Fire losses to timber resources alone are now some \$20,000,000 lower annually than they apparently would have been if national-forest fire-protection financing had been held at the 1927-31 level.

Gifford Pinchot National Forest

On June 15, 1949, the President signed a proclamation changing the name of the Columbia National Forest in the State of Washington to the Gifford Pinchot National Forest, in honor of a great conservationist.

Gifford Pinchot, who died in 1946, was the first American professional forester and first Chief of the Forest Service. It was he who gave the first great impetus to the movement for conservation of natural resources in America. He was a fearless, tireless champion of the public interest. The conservation program that got under way largely through his crusading efforts may well determine the future progress and security of this Nation.

The national forest named in Pinchot's honor was established in his early days and with his help. Managed in accordance with the principles for which he fought, it will henceforth bear his name as a permanent living memorial.

Timber Management

During the spring of 1949, uncertainty as to market trends caused some hesitancy on the part of purchasers of national-forest timber to enter into new contracts for long-term purchase of stumpage. Early and unusually heavy snows in certain areas of the West also affected logging output adversely. Nevertheless, harvesting of mature timber and cutting operations to improve the growing condition of national-forest timber stands are continuing at a rate well above that of the prewar years.

The total cut during fiscal year 1949 was 3.7 billion board feet, approximately the same as that of 1948. Receipts from timber sales increased substantially, from \$20,594,286 in 1948 to \$26,927,220 in 1949.

Maintenance of the present level of timber output will require opening up many areas now inaccessible. There is an urgent need for expansion of timber-access road construction in order to keep on supplying timber to the smaller operators who are dependent on national-forest timber, and to permit cutting operations in areas where losses are occurring because of overmaturity of timber, insect damage, or other causes.

The national forests could supply a sustained annual cut at least 50 percent above the present annual cut. More access roads will be needed, however, to increase the cut to the sustained-yield capacity of each national-forest working circle. The development of the full productive capacity of timberlands is dependent on repeated cutting operations, including thinnings, removal of insect-infested and diseased trees, and other improvement and salvage cuts, as well as pe-

riodic harvesting of timber as it matures. A permanent system of main timber-haul roads is therefore necessary. The added stumpage value of the timber and the increased growth made possible through proper cutting will soon return the cost of such roads.

Maintenance of the present rate of timber cutting, or its increase, also calls for advance preparation of timber-management plans. The administration of current timber-sale business, however, continues to absorb available manpower and facilities to such an extent that adequate timber inventories, determinations of allowable cut, and cutting plans are not keeping pace with present demand for timber sales.

Forestry practices to increase the productivity of national-forest lands are being improved constantly. An expansion of cutting operations to salvage mature, defective, and dying trees, and to thin out overcrowded stands for better timber growth is highly desirable. A larger force of trained foresters to handle such cutting operations would not only increase future returns from national-forest timber, but would more than pay its cost in greater immediate returns from the sale of stumpage.

In 1948, the Forest Service accepted a bid from the Ketchikan Pulp & Paper Co. for the purchase of a large volume of timber in the Tongass National Forest in Alaska. The company has made progress during the year in acquiring a site and developing plans for building a large pulp mill near Ketchikan. This sale of $1\frac{1}{2}$ billion cubic feet of pulp timber is a big step toward the realization of years of effort by the Forest Service for the establishment of industries in Alaska to utilize the timber resources of the national forests there and to contribute to sound economic development of the Territory. Five or six units similar to the proposed Ketchikan mill can be supported in perpetuity by the Tongass National Forest.

SUSTAINED YIELD UNITS.—The Flagstaff Federal Sustained Yield Unit was established on May 6, 1949. At a public hearing at Flagstaff, Ariz., in February, sentiment was almost unanimous that the establishment of such a unit in the Coconino National Forest, under provisions of the Sustained Yield Unit Act of 1944, would be in the public interest. Under the policy adopted, primary manufacture and reprocessing of at least 85 percent of the annual cut of timber in the unit will be required in the Flagstaff community, where 3 sawmills provide direct employment to about 750 persons. The allowable annual cut in the unit is 61,000,000 board feet. Small outlying mills dependent on national-forest timber are protected by the allocation of 15 percent of the allowable cut for sale to such mills. Establishment of the sustained-yield unit assures management and utilization of the timber for the continuing benefit of the Flagstaff community.

A hearing also was held in Quincy, Calif., on a proposal for establishing a Woodleaf Cooperative Sustained Yield Unit for coordinated management of public and private timber in and near the Plumas National Forest. Because of predominant local opposition, however, the proposal was dropped.

A public hearing was scheduled in August 1949, at Aberdeen, Wash., to consider the proposed Grays Harbor Federal Sustained Yield Unit. This proposal calls for primary manufacture in Grays Harbor County

of the 60,000,000 board feet allowable annual cut of national-forest timber. Local remanufacture would be encouraged. If established, the unit is expected to help materially in stabilizing the local economy of Aberdeen, Hoquiam, and other Grays Harbor County communities.

PROTECTION FROM INSECTS AND DISEASES.—In order to grow white pine—one of our most valuable timber trees—it is necessary to protect it from the fungus disease, white pine blister rust. A study of western white pine production on national forests in the northern Rocky Mountain area indicates that a sound program of management to provide for white pine production on the better growing areas will be required if the supply of this valuable wood, the dependent industries, and the local economy are to be maintained. The better white pine growing areas in the northern Rocky Mountain area constitute less than one-fifth of the total timber-growing area. Without careful management—in which blister-rust control is a key measure, along with prescribed burning, planting, weeding, and good cutting practices—the lands capable of producing the best white pine will produce only low-value species that have a slow rate of growth and a stumpage value only one-third to one-half that of white pine. These species would provide an uncertain economic base, because the margin between cost of production and market value is much narrower than for white pine.

The program recommended would be limited to what could be handled on an economical basis. White pine production would be concentrated on areas of high productive capacity and low protection cost—about one-half of the white pine producing lands within the national forests of the region. Present young timber stands would be fully protected against blister rust to prevent a rapid falling off of white pine production after the older timber was harvested. An annual yield of 300,000,000 board feet would be provided for, at a cost which would be expected to be returned through the increased value of the timber produced.

A similar study of the sugar pine stands of California is in progress.

Large-scale insect-control operations to check the spread of pine bark beetles and the spruce budworm defoliator were conducted during the year. The most serious situation that developed was the spread of the spruce budworm into one of the country's major timber-producing areas, the Douglas-fir region of western Oregon. The Forest Service, State of Oregon, and private owners cooperated in spraying some 250,000 acres of timber with DDT from the air. It is hoped this will prevent further spread of the infestation in the high-value Douglas-fir stands.

Bark beetle-control operations conducted in the Black Hills of South Dakota and in Idaho, Wyoming, and Montana greatly reduced the infestations. A small beetle infestation in the Kootenai National Forest in Montana was caught in the early stages and completely wiped out, preventing its spread to extensive stands of lodgepole pine in this area. Other smaller control operations, such as those against spittlebug and sawfly in tree plantations in the Lake States, saved much timber from the ravages of destructive insects.

REFORESTATION.—Approximately 44,000 acres of national-forest lands were reforested during the year. More than 4,000,000 acres in the national forests need planting to make them fully productive. The present rate of tree planting obviously falls far short of what would be required to accomplish the job within a reasonable time.

Development and use of machinery and chemicals for the control of weeds in the tree nurseries, and of machines for planting the nursery-grown seedlings is going forward to increase the efficiency and lower the costs of reforestation work. Two new nurseries have been developed by the Forest Service, one at Bend, Oreg., and another at Mount Shasta, Calif. These will supply nursery stock needed for reforestation in California and in the ponderosa pine regions of Oregon and Washington.

Range Management

During 1948 the Forest Service issued 3,114 charge permits for the grazing of 3,321,993 sheep, and 18,504 permits for the grazing of 1,153,246 cattle on national-forest lands. Including calves and lambs for which no grazing fee is charged and the additional livestock grazed under free permit to local settlers, approximately 9,000,000 domestic animals grazed national-forest ranges in 1948.

Grazing fees on the national forests are adjusted annually in accordance with the market price of beef and lambs for the preceding year. Under this procedure, cattle fees per head per month increased from an average of 40 cents in 1948 to 49 cents in 1949. Sheep fees increased from 10 cents in 1948 to 11 cents per head per month in 1949.

RANGE TRENDS.—Over the years grazing permittees and forest officers have recognized that a simple and easily applied method for determining whether a range is improving or declining in productivity would be a big help to effective range-management planning. Methods used in technical studies have proved too complicated and time-consuming for everyday use by range administrators and stockmen.

The Forest Service is now making a special study looking to the development of a simple, practical method of determining range conditions and trends. Such a method must be accurate, technically sound, and must yield definite measurements as well as observational evidence of trend. One man was assigned full time to the work in 1948. Special analysis was made of all methods used in the past and also of records on range conditions and trends maintained in the various national-forest regions. The study is being continued. Those methods that have given best promise will be tested out under field conditions.

RANGE IMPROVEMENTS.—More range-development work is still a pressing need on national-forest ranges. Without adequate provisions for range reseeding, construction of fences, water developments, and other improvements, proper management of these areas is impossible.

Congress appropriated \$820,057 for reseeding work in fiscal year 1949. To date upwards of 100,000 acres of range have been reseeded

in the national forests. At least 4,000,000 acres of range lands in the national forests are in need of reseeding and can be successfully reseeded. It is estimated that reseeding these lands would provide 2,500,000 additional animal-unit months of grazing. The Forest Service would like to undertake the reseeding work on a plan-wise basis that would insure completing the program in a period of 10 to 15 years. At the present rate, however, a much longer period will elapse before the whole reseeding job can be accomplished.

Lack of progress in the construction of fences, water developments, and other such improvements is even more discouraging. In fiscal year 1949 Congress appropriated \$128,000 for such work. This made possible only a small dent on the job to be done. Listed needs include some 30,000 miles of fence, 24,000 water developments, rodent-control work on 15,000,000 acres, poisonous plant and noxious weed control on 440,000 acres, and 9,000 miles of stock driveways.

CONTROL OF KLAMATH WEED.—The Bureau of Entomology and Plant Quarantine and the Forest Service have joined forces to control the spread of *Hypericum perforatum*, commonly known as Klamath weed or goatweed, an Australian plant that has gone wild in this country. Since its introduction on the west coast about 50 years ago, Klamath weed has spread progressively throughout the West, Northwest, and British Columbia. It is worthless for forage, poisonous when eaten in quantity by livestock, forms a dense cover, and constitutes a high fire hazard when dry. Once established, it is practically impossible to eradicate, and control is the most that can be hoped for. That it can be effectively controlled through colonization of two species of imported beetles, *Chrysolina gemellata* and *C. hyperici*, has been demonstrated by the Bureau of Entomology and Plant Quarantine. During their life cycles, the beetles feed exclusively on Klamath weed. Colonization of the beetles will control the weed to the extent that it will not form dense stands to the exclusion of the valuable range plants. The beetles are not injurious to crops. In 1949 about 20 colonies were liberated on western and northwestern national-forest ranges. In 1950 sufficient colonies will be available for general release.

Watershed Management and Flood Control

Problems of erosion, flood control, sedimentation, and runoff are receiving careful consideration in the administration of the national forests, and watershed-improvement work goes forward as rapidly as the availability of funds will permit.

Detailed data are particularly needed now on watershed conditions of many locally important subdrainages. Progress was made toward obtaining such data in a number of national forests of the intermountain region during the past year. An analysis showed that the watersheds above some 170 municipalities and villages are in need of physical improvements such as seeding, planting, contour terracing, gully-plugging, and fencing.

In California special problems relating to sustained water flow for complete resource use and development are being studied. In Colorado progress is being made toward completion of watershed analyses

for certain drainage basins which rate high in water production. Elsewhere, plans emphasizing the watershed-protection aspects of land management are being formulated on various national forests to aid in future progressive uses of the existing soil and water resources.

FLOOD-CONTROL PROJECTS.—The Forest Service is cooperating in flood-control projects authorized by Congress in the watersheds of the Los Angeles, Potomac, Little Tallahatchie, and Yazoo Rivers. Work on these projects, involving both national-forest and non-national-forest lands, continued during the year at an accelerated rate. Progress was made in roadbank erosion control, planting of eroding areas, timberland improvement, mountain channel stabilization, and improved fire control.

Two extensive burned areas involving portions of the Cleveland and Los Padres National Forests in California were treated as emergencies under provisions contained in section 15 of the 1944 Flood Control Act. In the case of the Wheeler Springs burn, cooperative action by Ventura County, the city of Ojai, the United States Army Engineers, and the Forest Service resulted in a quick, effective control program. Physical improvements consisting of a debris sump and channel clearing were constructed to protect life and property on Ojai and vicinity, immediately adjacent to the burned watershed. Some 25,000 acres of denuded lands were seeded from the air with quick-growing mustard, utilizing two fixed-wing planes and one helicopter.

To reduce the threat of floodwater and sediment damage to the areas below the Green River fire, 24,000 acres, or about 50 percent of the total burn, were seeded with mustard. Some 2,000 acres located in hazardous flying routes were seeded by a helicopter; the remainder of the project was covered with conventional aircraft. Cooperating in planning and financing the work were the California Division of Forestry, Orange County, the Irvine Co., the Carpenter and Serrano Irrigation Districts, and the Forest Service.

WATER RESOURCES.—Some \$300,000,000 worth of water flows annually from the national forests. Last year \$30,000,000 worth of hydroelectric power was generated from that water.

Applications to the Federal Power Commission for power permits and licenses since the end of the war were reported to cover almost as many kilowatts as were handled during the first 25 years of the Commission's existence (1920-45). This was reflected in a correspondingly large number of power cases which had to be investigated and processed last year by the Forest Service. Power permit and license fees collected for the United States Treasury and the States exceeded \$250,000.

Increased activity in the construction of water storage reservoirs also has affected the national forests. Replacement of roads, bridges, buildings, and other forest improvements that are inundated is becoming an increasing problem, into which the future values of the forests also enter. In this connection, the Forest Service is studying various river-basin and flood-control proposals to determine values affected, and land use considerations involved.

Recreation

Recreational use of the national forests is still increasing. The national forests received approximately 24,000,000 visits by recreationists during 1948, an increase of 13 percent over 1947. Public camp grounds, picnic areas, and winter sports areas had 12,500,000 visits. The other 11,500,000 visits were to organization camps, resorts, summer homes, wilderness areas, hunting country, and fishing streams.

For the first time in its history, the Forest Service in 1949 made a charge for use of some of the heavily used public recreation areas. This new departure was carried out on an experimental basis; only about 50 of the 5,000 existing camping and picnic grounds were placed on a charge basis. About half of these were operated by the Forest Service and the other half were operated by concessioners. The charge was kept nominal—for camping, a maximum of 50 cents per night or \$3 per week for a car party of not more than six people. The charge for picnicking was 25 to 50 cents per day per car party of six. No charge was made for children under 12 years of age.

The Forest Service was influenced in its decision to charge for use of public camping and picnic grounds by repeated suggestions from Congress and the Bureau of the Budget that recreational use in the national forests should bring in some revenue to offset, at least in part, the cost of recreational administration and maintenance of recreational facilities. In announcing that certain areas would be placed on a charge basis this year, the Forest Service stated that many small camp and picnic areas would remain free to the public.

Winter sports continued to be the fastest-growing recreation activity in the national forests. It accounted for over 10 percent of the total recreational use, and resulted in large private investments in the form of ski lifts and resorts. In the Western States the national forests provide the terrain for about 90 percent of the public skiing.

The avalanche hazard on ski terrain is a matter of constant concern. The Forest Service is doing everything it can to prevent accidents. A ten-year study of avalanche conditions and possibilities of control on the Wasatch National Forest in Utah culminated in the publication in 1949 of "The Alta Avalanche Studies" by Forest Supervisor Koziol and Forest Guard (Snow Ranger) Monte Atwater. This study is the first of its kind published in the United States and will be of great value as a guide to meeting avalanche problems in other national forests. The report has been highly praised by men familiar with avalanche-control problems in the United States and Europe.

The National Guard of Colorado and Utah cooperated with the Forest Service on experiments in the use of artillery projectiles for precipitating avalanches at a safe time. The preliminary results were encouraging and it is expected that this work will continue.

Special Uses

Some 47,500 permits are in force for special uses of national-forest lands. Special-use permits cover approximately 3,600,000 acres. Receipts from these uses during the fiscal year 1949 were \$720,528. Many small tracts are under permit for such varied uses as agriculture,

stores, resorts, ski lifts, telephone lines, railroads, pastures, and summer homes. Permits for uses which serve public purposes and are of a noncommercial nature are issued free, while commercial permits are issued at commercial rates.

Commercial public-service permits were placed on a new rental basis during the past year. Instead of a fixed rental, the permittee now pays the United States a percentage of the net sales of the business. The percentage varies with the type of business and the volume.

Hundreds of leases have been issued by the Department of the Interior for oil and gas development and for the exploitation of certain other minerals on national-forest lands. Use of national-forest lands for mineral development, particularly for oil and gas, is increasing and will require careful consideration and watchful management in order that the multiple-use policy of national-forest lands may be carried on in keeping with the best principles of land-use management. Some 5,000,000 acres of national-forest land are now covered by such leases and permits.

National-forest lands reserved from the public domain are subject to location and entry under the United States mining laws. The Bureau of Land Management in the Department of the Interior is primarily responsible for the administration of the mining laws, but the Forest Service is responsible for initiating protests against claims which are believed to be invalid or of which improper use is being made. Under the multiple-use management policy of the Forest Service, legitimate mining operations are encouraged on the national forests, but there should be adequate provisions for protecting the public interest in good land management, conservation of resources, control of soil erosion, and watershed protection.

Wildlife

Progress in meeting the Forest Service responsibilities in the management of the wildlife resources of the national forests was again hampered by an omission of specific funds for this activity in the Appropriation Act for 1949. As was the case last year, withholding the necessary funds did not reduce the urgency of the work. Accumulations of postponed projects compounded the difficulties that confronted forest officers.

The numbers of hunters and fishermen continued to increase. Some 1,700,000 hunters and 3,300,000 fishermen visited the national forests for a total hunting and fishing use of more than 20,000,000 man-days. The hunters, fishermen, and 52,000 trappers removed wildlife products valued in terms of meat, hides, and furs in excess of \$34,000,000. The value of the national-forest wildlife resource to business and local communities was also reflected in the millions of dollars spent for such items as equipment, groceries, gasoline, licenses, and guide hire.

Big-game herds in the national forests have increased to an estimated 2,470,000 animals. In a number of local areas big game has increased beyond the proper carrying capacity of its range. The States have cooperated with the Forest Service in efforts to remedy such situations, but lack of public understanding and support has hampered adjustment programs.

Throughout the West elk are reported to be spreading to new areas. In some sections this spread is resulting in increased numbers and an extension of present elk-hunting areas. But it is also creating winter range problems where elk and deer have inadequate browse.

There has been pressure from some quarters for the Forest Service to issue licenses and take other direct measures in areas damaged by excess populations of big game. It is the Forest Service policy, however, to seek control of wildlife populations through hunting by State-licensed hunters. The cooperative program with the States is being continued.

Improving conditions on the big-game overpopulated areas is only one segment of the work in wildlife management that needs to be done. On most of the hunting grounds within the national forests the wildlife management job is one of creating and maintaining a habitat capable of sustaining a reasonably abundant wildlife resource consistent with the requirements of other desirable forest uses. This involves the complex job of integrating the requirements of the wild animals with such uses of the forests as timber growing, livestock grazing, and watershed protection.

COOPERATIVE ACTIVITIES.—Despite the handicaps prevailing during the past year, the Forest Service has tried to further its program of cooperation with the various State wildlife authorities.

A cooperative livestock-deer relationship study of the northern section of Kaibab National Forest (Grand Canyon National Game Preserve) in Arizona was continued. A great deal of information was gathered which will be helpful in effecting better management of this herd.

The national forests in Utah, Nevada, southern Idaho, and western Wyoming cooperated with State wildlife authorities in planning and carrying out a total of 95 special hunts on overpopulated areas during the year. Special hunts were also conducted on a number of problem areas in other regions.

A successful open season on Chukar partridge, believed to be the first in this country, was held in Nevada during the year. The hunting territory included several areas on the Toiyabe National Forest.

In West Virginia the first open trapping season for beaver in many years was held in 1948. Beaver had been extinct in West Virginia, so about 20 years ago the Forest Service and the West Virginia Conservation Commission jointly undertook to restock these animals in the Monongahela National Forest. Live beavers were imported from the Lake States and released at a number of points. From this initial stocking, the animals multiplied and spread to adjacent areas until the population was estimated at approximately 2,000 animals in the fall of 1947. At that time the conservation commission and the Forest Service jointly worked out a program which included an open trapping season during February 1948.

Under the Act of July 30, 1947 (61 Stat. 516), the Francis Marion National Forest Wildlife Management Preserve was established in South Carolina. The main purpose of this preserve is the perpetuation of the wild turkey. A Pittman-Robertson turkey restoration project has been initiated by the State of South Carolina. Plans provide for eventual utilization of surplus turkeys by public hunting.

Throughout the reforestation areas of the Lake States special consideration is being given to wildlife requirements in tree-planting programs. Planting furrows are kept as shallow as possible. Small openings and feeding areas are reserved in accordance with principles developed on the Udell Demonstration Area in the Manistee National Forest. The Upper Michigan National Forest is reserving two unplanted strips through each 40 acres of plantation, for hunter access and to increase the amount of forest "edge."

With the development of a pulp and paper industry in prospect in Alaska, control and prevention of water pollution by pulp-mill waste is being closely studied. Forest Service officers in Alaska and officers of the Fish and Wildlife Service are cooperating in developing logging practices that will prevent damage to salmon spawning streams.

Fire Control

At midyear in 1949, the Forest Service had fought 3,740 fires in the national forests. All but 21 of these were controlled within the first 24 hours. The burned area was held to 41,791 acres, compared with an average of 97,487 acres for the corresponding 6-months periods in the preceding 5 years.

Fire danger was extremely high in several of the regions as the Service entered the latter part of the 1949 fire season. In August, a tragic loss of life occurred during a fire in Helena National Forest, Mont. Sixteen fire fighters were trapped by the flames; only three came out alive.

During the calendar year 1948, a total of 2,892 lightning-caused and 5,453 man-caused fires were controlled by forces employed by the Forest Service or by action of its cooperators. These fires burned 130,193 acres of national-forest lands and 46,629 acres of private lands inside national-forest boundaries. The cost of fighting these fires approximated \$3,000,000.

BURNED-AREA OBJECTIVES.—If coordinated, multiple-use management of forest resources is to be successful, fire losses must be held to a low figure. On the national forests, the objective has been to hold annual fire losses of commercial timber and important watershed lands within one-tenth of 1 percent of the total area of such lands being protected, with two-tenths of 1 percent as the maximum loss that can be tolerated on all other lands.

These burned-area objectives may be met for the national-forest system as a whole in a given year, or even for several years running. At first glance this would seem to indicate successful fire control. The success of fire control, however, cannot be judged wholly on this basis; it must be judged on the extent of fire losses occurring in individual management units, not for a single year but for a long period—in some instances more than 100 years.

The importance of localizing burned-area objectives to measure the success or failure of fire control is emphasized by studying the fire history of individual management units. A national-forest management unit in California furnishes a good example. This unit con-

tained 813,000 acres of virgin timberland and supported approximately 16,000,000,000 board feet of timber in 1905. From 1905 to 1948, fires burned 121,000 acres. The volume of timber destroyed amounted to 2.4 billion board feet or 15 percent of the original capital stock. The average annual burn exceeded 0.3 percent, more than three times the amount established as the maximum annual loss that could be tolerated if successful management of timber and other resources were to be practiced. Moreover, the 121,000 acres burned over has reverted to brush fields and will require costly planting before it will again produce timber. Direct and indirect loss to society since 1905 due to fires within this management unit is estimated at more than \$150,000,000.

Another national-forest management unit in South Dakota, containing about 640,000 acres of commercial forest lands, has also been hard hit by forest fires in the past 50 years of its history. More than 80,000 acres of timberlands have been burned. As in the case of the California unit, successful coordinated management of the natural resources will prove impossible if such losses are permitted to continue. Many other areas where fires have been very destructive further emphasize the importance of adequate, sustained fire protection.

MEETING THE FIRE-CONTROL OBJECTIVES.—In 1948 the ratio of the total area of national-forest lands burned over (130,193 acres) to total area protected (185,382,603 acres) was about 1 acre of burn for each 1,400 acres protected. This was well below the burned-area objective of 0.1 percent. Therefore, for the national-forest system as a whole, fire protection was successful in 1948. Fire losses on many national forests and individual management units, however, exceeded the tolerable burn, and for those forests or units fire protection in 1948 was a partial failure. Such failures occurred on the Cibola National Forest in New Mexico; the Coconino, Tonto, Coronado, and Sitgreaves in Arizona; the Boise in Idaho; the Mendocino, Modoc, Cleveland, and Los Padres in California; and several national forests in other States.

These local failures occurred during one of the better accomplishment years of record in the control of forest fires in the national forests. Fire weather generally was normal, or better than normal, except in southern California, New Mexico, and Arizona, and for short periods in certain other areas.

Under present conditions the Forest Service is able to provide a protection force and facilities capable of controlling fires that start during periods of normal or better than normal fire weather before extensive damage results. It is unable to guarantee against serious losses on critical fire-weather days. Hence, fire weather conditions are still the controlling factor determining whether the loss of resources will be high or low.

Sound business management dictates that a fire organization of sufficient strength and continuity to meet all conditions of fire weather should be provided. A better financed, more adequate fire-control organization will be necessary to assure protection of the national-forest resources from fire at all times and under all conditions.

EQUIPMENT AND TECHNIQUES.—Earlier reports have emphasized the importance of specialized equipment, such as tractor dozers and plows, tank trucks, powered chain saws for felling snags and clearing logs from fire lines, airplanes for cargo dropping and transportation of personnel, all-wheel drive equipment, and numerous other items to increase the speed and effectiveness of fire suppression.

The use of such equipment is increasing. Use of smoke jumpers (parachuting fire fighters) to control fires that occur in inaccessible areas in Idaho, Montana, Oregon, Washington, and northern California has become regular operational procedure. Smoke jumpers were also assigned to the Gila National Forest in New Mexico in 1948. Here, 8 men were able to control 24 potentially damaging fires in about 5 weeks of operation.

An operational experiment with the helicopter was undertaken during 1948. Results of this experiment, though not conclusive, indicate the general utility of this piece of equipment to (1) transport key fire personnel overhead, thus saving much time and work in scouting and in the preparation of plans to control a serious fire; (2) deliver men to fires in isolated areas or directly on weak sectors of a dangerous fire, and (3) return smoke jumpers from fires, thus making the same men more quickly available to jump to other fires.

The Forest Service Radio Laboratory early in 1949 completed development work on new radio equipment especially designed for economical and reliable communications in combating forest fires. Light-weight, battery-powered, frequency-modulated radio equipment of the design and type required were not available from commercial sources when the development program was begun. The sets developed feature two-channel transmitters which afford greater flexibility of use and conserve radio frequencies. Two large radio manufacturers have agreed to produce the 10-pound handy-talkie model and the model used at lookout stations. This makes the equipment available at commercial prices instead of custom-built prices not only to the Forest Service but to State forestry agencies and other fire-protection organizations.

Improvements and Facilities

FOREST DEVELOPMENT ROADS AND TRAILS.—During the fiscal year 1949, expenditures on development of the national-forest road and trail system approximated \$12,000,000. The appropriation for this was \$9,892,000; the balance of \$2,108,000 was from 10 percent road funds (10 percent of each year's national-forest receipts are earmarked by law for road construction and maintenance).

Maintenance work to preserve the investment in the national-forest transportation system was accomplished on about 75,000 miles of roads and 88,000 miles of trails, at a cost of approximately \$8,000,000. This included replacement of gravel surface on at least 500 miles of road at a cost of \$600,000. Also some 300 old timber bridges were replaced at a cost of \$1,300,000 because they were unsafe.

The balance of less than \$4,000,000 available for new construction and improvement was wholly inadequate to meet urgent needs for log-hauling roads and other forest-traffic facilities. Many miles of

forest roads are unsatisfactory for heavy log loads. Others are dangerous for the increased postwar public forest travel. It is estimated that \$100,000,000 over a 5-year period is needed for main tap roads to open up remaining large stands of national-forest timber. Lack of such roads is hampering forest management, and millions of board feet of timber are being lost each year through insects, disease, and rot, that might otherwise be salvaged.

AERIAL PHOTOGRAPHY AND MAPPING.—Approximately 5,970 square miles of planimetric surveys for mapping were completed in four western regions during the year. Five 15-foot quadrangles of standard topographic mapping were completed and eight were published for administrative use. Control for mapping was in progress on areas totaling 8,044 square miles. In terms of progress on the entire mapping program, an estimated total of 1,750 square miles of standard topographic mapping was completed.

Contracts for aerial photographing covering approximately 15,800 square miles were placed. Through the cooperation of the Navy, 25,000 square miles of aerial photography was obtained in Alaska.

In addition to the standard quadrangles and 12 national-forest recreational folders published, 22 administrative maps were lithographed during the year.

National-Forest Properties

As of June 30, 1949, the Forest Service was responsible for administering 152 national forests, 39 purchase units approved under the Weeks law, 18 experimental forests and ranges, and 8 land-utilization projects administered for forestry and watershed purposes. Gross area within the boundaries of these properties is 229,174,789 acres, and the net area of Federal lands managed by the Forest Service is 180,373,788 acres. This net area represents an increase of 609,286 acres during the fiscal year 1949. The Forest Service also administers 91,820 acres of land acquired by the United States for rural-rehabilitation purposes, and is also the custodian of the Federal interests in 476,176 acres of land-utilization project lands managed for forestry purposes by several States under lease and cooperative agreements.

BOUNDARY CHANGES AND REALINEMENTS.—During the past year four public-land orders were issued making interforest boundary adjustments in the interest of efficient management. Three orders of the Secretary of Agriculture formally added purchased and donated lands to particular national forests for administration.

Public Law 79, approved May 31, 1949, extended the boundaries of the Carson National Forest in New Mexico to include about 15,000 acres of forest and watershed lands largely owned by the State of New Mexico. Acquisition of such land by exchange of national-forest lands more suitably located for State management may follow.

LAND PURCHASES.—The appropriation for acquisition of lands pursuant to the Weeks law of 1911, as amended, was \$500,000; and that for purchase under the several "receipts acts" applicable to certain national forests in Utah and California was \$137,584.54. Under these appropriations 154 tracts involving 46,282 acres were approved by the National Forest Reservation Commission for purchase pur-

suant to the Weeks law, and 13 tracts aggregating 6,935 acres will be acquired under the receipts acts. Lands so approved for purchase are situated in 33 national forests or purchase units in 21 States and Puerto Rico. While the acreage that will be purchased under these appropriations is very small in relation to the area that must be acquired to consolidate existing national forests and purchase units, the approved purchases include a good many key parcels public ownership of which will be most helpful in promoting forest conservation on the ground.

FOREST EXCHANGES.—During the year 177 applications to exchange non-Federal land within or near the national forests for national-forest lands or timber were received, reviewed, and approved. Included are several substantial exchanges with the State of Michigan designed to consolidate both national forests and State forests and parks. Included also were many relatively small transactions that will help to build up small farms and other privately owned properties within the forests, while at the same time increasing the area of national-forest land suitable for timber production and watershed improvement. During the year title was accepted to 290,442 acres offered to the Government in exchanges. For such land approximately 43,618 acres of national-forest land and cutting rights to 187,239,000 board feet, more or less, of national-forest timber were, or will be, granted.

All of these boundary adjustments and acquisitions are aimed at building the national forests and other projects administered by the Forest Service into more integrated, manageable, and useful conservation instruments. Within established national forests and purchase units, some 35,000,000 acres of private forest and watershed lands still remain to be acquired. In many of the national-forest purchase units established under the Weeks law less than half of the area suitable for public forestry purposes has as yet been acquired. It is to be hoped, therefore, that the acquisition program authorized by the Weeks law and the Clarke-McNary Act may soon be resumed on a scale more commensurate with the public needs.

PERSONNEL

SAFETY.—In July 1949 the Forest Service completed a full 12 months without a fatal accident—the first fatality-free year in the Service's records. Gratification over this achievement was short-lived. The fire blow-up on the Helena National Forest in Montana that caused the death of 13 fire fighters early in August was one of the most serious fire tragedies of recent years. On other forests, three additional deaths from fire fighting occurred during the same month.

This was a disheartening setback in the Forest Service program to promote the safety of its employees. The Service-wide accident-prevention program, however, is bringing some encouraging results. Lost-time accidents in 1948 were reduced 25 percent below the 1947 figures. Accidental deaths, which averaged 12 annually in the decade preceding 1948, were reduced to 2 in that year.

The hazardous nature of fire fighting and many other Forest Service activities makes for a high accident risk, but an intensified safety program is steadily bringing down the over-all accident rate.

RECRUITMENT AND TRANSFERS.—Reestablishment of competitive recruiting processes by the Civil Service Commission, beginning in 1946, made available registers of eligibles for filling most vacancies (and many positions occupied by temporary employees). Some 200 junior-professional eligibles were appointed during the year.

Numerous transfers of personnel to and from key administrative positions were required during the past 2 years to readjust for changes resulting from the war. A more normal situation has now been attained. It should now be possible to increase the tenure of occupancy in the key positions, with consequent improved employee morale and efficiency of operations.

TRAINING AND DEVELOPMENT.—Training and development of Forest Service personnel is a continuing activity, closely associated with realistic aspects of administrative management and work supervision. Orientation and induction-period training of junior-professional employees recruited since the war was largely completed during the year. Regular on-the-job training continues. Several excellent training programs were carried out on experimental forests and ranges to provide up-to-the-minute technical information to officers responsible for administration of forest and range resources on the national forests.

EMPLOYEE INCENTIVE PROGRAM.—Efforts to obtain wider participation by all personnel in a program of work improvement resulted in the submission of 504 work-improvement suggestions. Many of these proved well worth while, and resulted in increased efficiency of operations. Cash awards were made for six of the most outstanding suggestions.

RETIREMENTS.—During the year 72 employees retired for age or by option, with average Government service of $29\frac{1}{4}$ years and an average age of 62 years. An additional 51 employees retired because of disabilities.

STATEMENT OF RECEIPTS AND EXPENDITURES

NATIONAL FORESTS.—Receipts from the national forests during the fiscal year 1949 totaled \$31,992,033, of which there is held in suspense pending determination of proper disposition \$783,631 from revested Oregon and California Railroad Co. grant lands and \$132,310 in Alaska from the Tongass Forest, leaving \$31,076,092 for deposit to the Forest Reserve Fund. Of this total \$26,927,220 was from timber; \$3,275,964 from grazing; and \$872,908 from special land uses, water power, etc. Of the amount credited initially to the Forest Reserve Fund \$60,775 was returned to Arizona and New Mexico on account of State school lands within national forests; \$43,548 was paid to Minnesota representing three-fourths of 1 percent of the appraised value of lands in the Superior National Forest described by act of June 22, 1948 (Public Law 733); and \$136,240 was appropriated for acquisition of national-forest lands. Distribution of the remainder was as follows: Paid to States for benefit of public schools and public roads of the counties in which national forests are situated \$7,719,494; appropriated for expenditure by the Forest Service for roads and rails within national forests \$3,087,908; balance to the general fund of the United States Treasury \$20,028,127.

Expenditures for national-forest operation, protection, and management were \$32,356,605. Additional expenditures from appropria-

tions for forest roads and trails amounted to \$12,088,107. \$544,991 was expended for acquisition of national-forest land.

AID TO STATES.—Forest Service expenditures for cooperation with States and private agencies in fire control, planting, and assistance in forest practice were \$9,640,247.

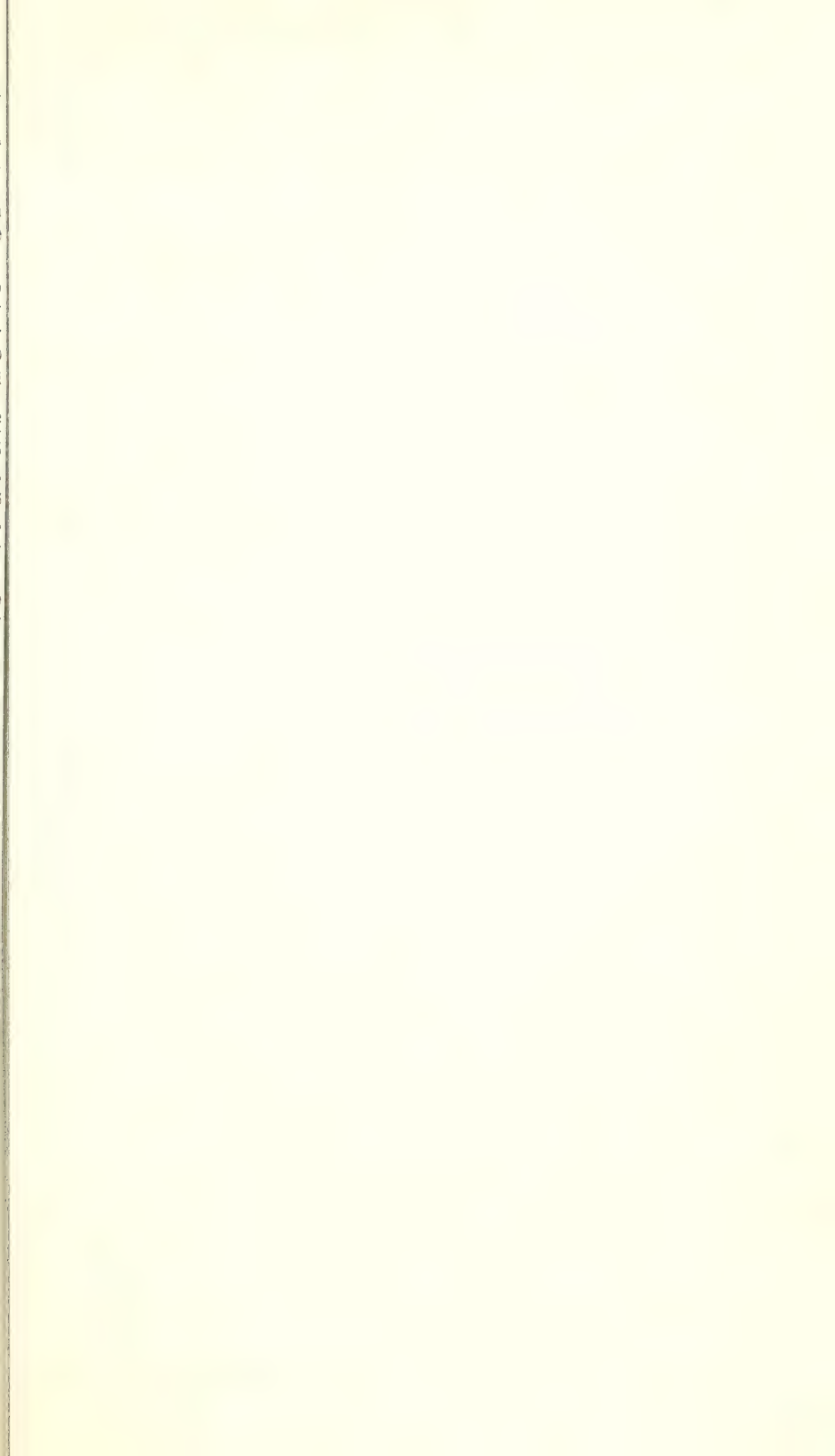
RESEARCH AND MISCELLANEOUS.—Expenditures for forest research were \$5,181,435; for flood control \$1,529,522; general administrative expense \$686,823.

There was also expended \$5,785,273 for fire control, slash disposal, improvement work, timber-stand improvement and other work financed by outside agencies and from funds derived from national-forest resources. Also, services for the Insular Government, Puerto Rico \$1,407; emergency reconstruction and repair \$3,991,065; and from proceeds of sale of parts and equipment \$571,433.

Services for other Government agencies involved expenditures of \$812,193, including \$113,585 for the Interior Department; \$317,653 for the Army; \$157,993 for the Navy; and \$222,962 for other agencies.

Total net expenditures were \$73,189,101. In addition, expenditures for which appropriations were reimbursed amounted to \$5,090,654. Expenditures were accounted for by objective and functional classifications under 105 separate appropriation titles.

The Forest Service handled the naval stores conservation program, involving payment of \$249,209 from funds of the Production and Marketing Administration.



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REPORT *of the* *Chief of the Forest Service*



COOPERATION IN FORESTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,

Washington, D. C., September 15, 1950.

HON. CHARLES F. BRANNAN,
Secretary of Agriculture.

DEAR MR. SECRETARY: In these troubled times it is more than ever necessary that our Nation make and keep itself strong—strong in its determination to uphold the principles of freedom and democracy, and strong in material resources to back up that determination.

The resources of the forests are among those on which our strength will depend. Over the years our forest resources have been freely used and the timber-growing stock has seriously deteriorated. Progress is being made toward rebuilding forest growth and applying to forest lands the type of management that will keep them producing continuously. The progress generally has been best on public lands, poorest on private lands in small holdings. We still have a very long way to go to achieve a satisfactory forest economy.

In this country the bulk (76 percent) of the commercial forest land is in private ownership. Some owners are managing their forests well, from the standpoint of building up and maintaining productivity. But a far greater proportion are not. The Forest Service is cooperating with State forestry agencies in a number of programs to encourage, aid, and facilitate the protection and sound management of private forest lands. Because of the importance of the private forests in our total forest economy, special emphasis has been given to these cooperative programs in this year's report.

The world situation today demands that we take prompt and adequate measures to make and keep our forests permanently productive.

Sincerely,

LYLE F. WATTS,
Chief, Forest Service.

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Report of the Chief of the Forest Service

Cooperation in Forestry

It is the responsibility of the Forest Service to promote sound management and wise use of all our forest lands—so that the one-third of the Nation's land area that is forest land will contribute its full share to the Nation's welfare and security.

In working to meet this responsibility, the Forest Service proceeds along three main lines—research to develop better methods of handling forests and utilizing their products; administration of a 180-million-acre system of national forests; and cooperation with the States and with private forest owners for the protection and good management of State and private forest lands.

Three-fourths of the commercial forest land in the United States is privately owned. It is generally the best timber-growing land, and the most easily accessible. It furnishes us most of our timber products today, and we must look to it for the bulk of our timber supply in the future. Much private forest land is watershed land, important in the regulation of stream flow and control of floods, and important as a source of water for agricultural, industrial, or domestic use.

Work in the interest of sound management and wise use of this vast area of private forest land therefore is one of the Forest Service's biggest and most important jobs. This year's report reviews each of the programs designed to encourage and improve private forest-land management. We wish to give full recognition to the possibilities for good in each of these programs, and to present the best possible evaluation of progress. Then in summary, beginning on page 30, we shall weigh total progress against total needs in the management of privately owned forest lands.

THE RESPONSIBILITIES OF FOREST OWNERSHIP

Through grants of land by the English Crown to early colonists on the eastern seaboard, through "bonuses" of land to veterans of the Revolutionary War, through State grants and sales, through generous Federal land laws to encourage settlement and development of the West, most of the forest land in the United States came into private ownership. Only the more remote, inaccessible forests, chiefly in the western mountain country, remained in the public domain.

Today, of the 461 million acres of commercial forest land—that is, land capable of and available for producing timber of commercial quantity and quality—345 million acres is privately owned. About 89 million acres is in Federal ownership, and 27 million acres is owned by States, counties, and municipalities. Another 163 million acres is classed as noncommercial forest land—mostly alpine, semidesert,

chaparral and other forest types not suited for commercial timber production—is about equally divided between public and private ownership. Much of this noncommercial forest land is valuable for watershed protection, grazing, wildlife, or other purposes. It includes, also, some good forest land set aside for parks and game preserves.

The huge and seemingly unending task that faced the early settlers was clearing land for farming. Farmers whittled away at their woodlands, using some of the timber for building their houses and barns, for fences, fuel wood, and other farm needs. Timber was such a drug on the market and so much an obstacle in the path of expanding agriculture that much of it was merely felled and burned in land clearing.

With the growth of towns and cities came a rising demand for lumber. Timber operators acquired large forest holdings. Usually they looked for profits from two different sources—from cutting and selling lumber, and from selling the cleared land to settlers.

Land was cheap; timber was cheap. The owner of forest land usually aimed at getting an immediate return through liquidation of the stumpage values, or at holding the land for speculation and resale. Until Gifford Pinchot and his small band of pioneer conservationists began, a few decades ago, to preach the gospel of forestry, few ever thought of holding and managing woodlands for permanent production.

More and more owners are now managing their forests for continuous crops of timber. Private forestry has made notable gains during the past 10 years.

The Public Interest

During recent years, there has been a growing realization that ownership of land carries with it certain responsibilities as well as privileges.

We have received the world as an inheritance, said the French philosopher, Joseph Joubert. None of us has a right to damage it, and everyone has the duty to leave it in an improved condition.

Whether owned collectively by the public or individually by private owners, forests are a resource of importance to the whole of society. They support major industries and provide employment and income for millions of people. They furnish the raw material for thousands of commodities that contribute to our standard of living. They help to safeguard vital water supplies and prevent disastrous floods. They have recreational and esthetic values that are priceless.

In the national interest—and for the long-term interest of individual owners—our forest resources must be maintained. They are needed now, and they will be needed in the future. Our generation has an obligation to the next, to use its resources wisely and not hand our children a depleted, worn-out country.

Forest land ownership thus carries with it not only the privilege of using the products of the land for the owner's own welfare, but also the responsibility of making the land do its full share in the production of a nationally needed resource. It carries the responsibility of keeping the land permanently productive. While we safeguard the privilege, we must make sure the responsibility is met.

The right to own and use private property is one of the funda-

mentals of our democratic system. We Americans cherish this right. We cherish the opportunity for individual initiative and enterprise in the development and use of our property. It is one of the things that has made our Nation a great one and a good one to live in. It is part of the American way.

Our problem, then, is to safeguard individual enterprise in the use of natural resources and at the same time protect the public interest in those resources.

This may not be easy. But the Forest Service believes it can be done. It must be done if our Nation is to continue healthy and strong.

THE COOPERATIVE PROGRAMS

Since in the United States the privately owned forest lands are especially important in the national economy, promotion and encouragement of good forestry on these private lands must be an essential part of the Nation's forest conservation program. The Forest Service is endeavoring to meet its responsibilities in this field through several programs carried on in cooperation with the States.

Over the years, the Forest Service has encouraged the building up of strong, nonpolitical forestry agencies in the States, so that the States could effectively do their share of the job. It is anxious to see the State forestry agencies further strengthened and supported.

The first State forestry department was established in California in 1885. Within a few months Colorado, New York, and Ohio also organized State agencies for forestry work. Eight years later, however, all of these States except New York had discontinued their forestry departments. A new start was made after 1900. Today all of the 48 States and the Territories of Hawaii and Puerto Rico have agencies engaged to a greater or less extent in forestry activities.

The Weeks Act, passed by Congress in 1911, laid the ground work for regular Federal-State cooperation in forestry. Although cooperative effort under this act was limited to fire control, the act was a great stimulus to the establishment and development of effective State forestry agencies. The Clarke-McNary Act of 1924 greatly broadened the basis for cooperative work. It is under this basic act, with its subsequent amendments, that the major Federal-State cooperative programs in forestry are carried on today.

Protecting the Forests From Fire

If our forests are to continue productive, if they are to do their part in the protection of watersheds and provide their many other benefits to the people of this country, prevention of needless losses from forest fire is a basic need. The Federal Government, most of the States, and many counties and private owners are united in a cooperative effort to meet that need.

During the 1800's a number of great forest fire disasters temporarily shocked the Nation. Among these was the Peshtigo fire of 1871 in Wisconsin, which swept over 1¼ million acres, destroying several towns and many homes, and taking the lives of 1,500 persons. This fire, incidentally, occurred on the same day as the famous Chicago fire, and for that reason got scant attention in the newspapers, although the Peshtigo forest fire caused a far greater loss of life. In

1894 the Phillips forest fire in Wisconsin and the Hinckley forest fire in Minnesota caused great damage and made headlines for a day or so. But they were soon forgotten by the general public. Aside from the fire patrol started on Federal forest lands when the establishment of national forests began in 1891, and the early and isolated efforts of some timberland owners to protect their own merchantable timber, there was almost no attempt at systematic protection of the forests from fire before the turn of the century.

Soon after, however, some of the Northeastern and Lake States began to develop protective work. The tremendous losses caused by the great western forest fires of 1910 gave new impetus to thoughts concerning the need for State-wide fire protection that had been gradually taking shape. In the Pacific Northwest States, and to some extent elsewhere in the West, groups of large timber owners had begun to set up joint protection associations, realizing that instead of each owner trying to protect his own property, it would be far more effective and much cheaper to pool their protection efforts. The owners shared patrol and fire-fighting costs on an acreage basis.

The Western Forestry and Conservation Association, organized in 1909 by forest owners in the Northwest, was a pioneer in promoting forest-fire protection through cooperative action. It played a leading role first in sponsoring private protection associations and later in pushing for fire-control legislation at both State and National levels.

A weakness of the private association pattern of cooperative protection was that the paying members often were compelled to protect intermingled forest lands of nonmembers in order to protect their own timber. There was no way to require participation of all forest land-owners in a given locality. To correct this situation, and also to obtain public backing for State-wide protection, the protection associations sought legislation that would require forest-land owners either to protect their lands themselves or to pay the State or the association for their protection.

The first of these so-called "compulsory patrol tax laws" was enacted in Oregon in 1913. Washington, Idaho, Montana, and California soon enacted similar laws. But the general trend in other parts of the country was toward major assumption of fire protection responsibility by the States, and this is the pattern now prevailing. California repealed its compulsory patrol tax law in 1941, and in those Northwestern States where such laws are still in force, the private protective associations have been incorporated into the State-wide system under the supervision of the State foresters.

The Weeks and Clarke-McNary Acts

As might be expected, the main interest in these early private efforts was in protecting merchantable timber. The public interest, however, also required the protection of the young growth that would provide future timber crops, of cut-over and burned-over lands that should be restocked to timber, and even of "worthless" brush that (it was coming to be realized) was of tremendous importance for watershed protection. Congress about this time was becoming concerned over the large annual damages from needless fires. It began to appreciate that the general public had an important stake in forests regardless of ownership and that consequently the Federal Government should share in the cost of their protection. With respect to non-Federal forest lands

Congress adopted a policy of Federal cooperation with the States and through them with private owners by furnishing advice, technical assistance, and financial aid to locally administered protection agencies.

This was the policy expressed in the Weeks Act of March 1, 1911. This measure authorized the Secretary of Agriculture to cooperate with the States for the protection of forested watersheds of navigable streams. During the first year of the Weeks Act, 11 States qualified for Federal cooperation—Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, New Jersey, Maryland, Wisconsin, Minnesota, and Oregon. Some degree of protection was being given on about 61 million acres of State and private forest lands. During the next 13 years, 19 additional States entered the cooperative program, and the area under protection was increased to 176 million acres. The maximum annual Federal appropriation under the Weeks Act, however, was only \$400,000.

The Clarke-McNary Act of June 7, 1924, materially expanded the scope of Federal cooperation with the States in fire control. It authorized Federal aid in protecting forested and cut-over lands for the purpose of timber production, whether or not they were located on watersheds of navigable streams. By an early amendment, the measure also provided for protection of critical nonforested watersheds from which water is obtained for domestic use or irrigation.

Under the Clarke-McNary Act, Federal appropriations were increased substantially, and this in turn stimulated larger appropriations by the cooperating States. During the first fiscal year after the law became operative, a total of \$2,500,000 of Federal, State, and private funds was spent in protecting 193 million acres of land. Toward this total the Federal contribution was \$660,000.

In 1950, 43 States and the Territory of Hawaii were participating in the cooperative fire control program under the Clarke-McNary Act. The only States not participating or expected to come into the program were Kansas, Nebraska, and Arizona, States with relatively little State and private forest land. Wyoming and North Dakota may be included in the program in the near future.

The area placed under organized protection has doubled since 1925. Funds available for protecting non-Federal land have increased more than tenfold. For the calendar year 1949 they amounted to \$29,059,835, including \$20,059,835 of State and private funds and \$9,000,000 of Federal funds.

The Civilian Conservation Corps, which operated from 1933 to 1942, was a big help in strengthening fire control on State and private lands as well as on Federal lands. It enabled many States to build substantial fire lookout towers, buildings, and other facilities which they had previously been unable to finance. The corps constructed thousands of miles of truck trails, firebreaks, and telephone lines, put in numerous water holes, and reduced fire hazard along many miles of roads. During the life of the program, CCC boys in all cooperating States constituted the principal fire-suppression forces.

Recent Advances

During the past decade, organized protection was extended to 8 million new acres, on the average, each year. The cooperating State forest fire control agencies made rapid strides, too, in the three seg-

ments of fire control—prevention, presuppression, and actual fire fighting.

The cheapest and quickest way to stop a fire is to prevent its starting. Nine out of ten forest fires are man-caused and so are preventable. The message of fire prevention is being widely disseminated. A Nation-wide cooperative forest fire prevention campaign, started in 1942, has done much to create a better understanding of the need for care with fire in the woods and the values at stake. The campaign is sponsored jointly by the State forestry departments, the United States Forest Service, and the advertising industry, through its Advertising Council. Local business firms and other interests also cooperate in many places. Business concerns, advertisers, broadcasters, newspapers, and other cooperators are contributing advertising space and facilities to the campaign that would be worth some \$4,000,000 yearly at commercial rates.

This Nation-wide campaign needs to be and is being supplemented by localized fire prevention programs, such as the "Keep Green" programs sponsored by the forest-products industries and now organized in 28 States, and the extensive and growing fire prevention efforts carried on by State forestry agencies.

It is not possible, of course, to say how many fires have been prevented because of these educational efforts, but it is certain that the programs are paying off in fewer fires. The Nation-wide total of fires during the past few years has averaged consistently lower, although human use of the forest areas has increased over that of the prewar years.

Within the past few years a number of States have enacted laws governing forest practices that include fire prevention requirements of a standard higher than those covered by the regular fire laws. These require such things as clean-up around logging operations and sawmills, preparation of fire plans, and maintenance of fire-fighting tools and equipment. These precautionary measures, together with frequent inspections to enforce them, have no doubt been effective in reducing fire losses. Although closing of forests and shutting down logging operations as emergency fire prevention measures are not new ideas, more effective use of these measures is being made during periods of extreme fire hazard. Better appreciation of the need for such drastic measures is lessening the opposition of hunters and recreationists.

In some sections of the country, public sentiment is so strong against forest fires that little recourse to law enforcement is necessary. In other sections stringent laws and aggressive law enforcement are major needs, especially in those localities where incendiarism or intentional "woods burning" is a common practice and educational efforts have so far been ineffective. Marked progress in law enforcement is being made in most of the States. In 1949 there were 6,880 prosecutions by the 43 cooperating States for violation of State fire laws. Of these 95 percent resulted in convictions.

With increasing experience and knowledge of the fire control problem, the States have made notable progress during recent years in all phases of preparation for forest fire control—or "presuppression," as the fire control authorities call it. They have developed more effective organizations, more experienced personnel, better planning and training for the job, better supervision and inspection, wider fire

detection coverage, more and better communication and transportation facilities, and more and better equipment.

Through research at the Forest Service's regional forest experiment stations and elsewhere much progress has been made in developing techniques for measuring and forecasting fire danger conditions. Fire danger rating meters developed by several of the Forest Service experiment stations are now extensively used by State agencies. As more dependable information is obtained concerning the complex relations between weather, fuels, fire occurrence and behavior, and other interrelated elements, fire control administrators will be able to utilize available personnel and facilities more effectively.

Progress in fire fighting has kept pace with the advancements in fire prevention and presuppression. The States during the past few years have strengthened their fire-fighting forces both in size and in striking power. They now have more and better facilities for combating fires than ever before and are continually improving their suppression techniques. In the national-forest regions, close cooperation and friendly give and take between the State and national-forest protection forces make for mutual effectiveness.

In earlier days forest fire fighters relied mainly on axes, shovels, and other hand tools. Although there is still need for some handwork on nearly every fire, most of the States are rapidly converting to mechanized equipment. More extensive use of fire-line plows in the Southern and Lake States, and of bulldozers in the Lake States and in the heavily timbered Western States, has stepped up the efficiency of fire suppression wherever these types of equipment can be used. Four-wheel-drive jeeps and trucks equipped with water tanks and power pumps are proving their worth. The construction of new lookout towers means better area coverage for quick detection of fires. Many of the States now use air patrol to aid in detection when visibility from stationary lookouts is poor. A few States own airplanes, but most find it cheaper to contract for their use as needed.

Radio has been a big help; rapid communication is essential in forest fire control. Most States now have two-way radio installations on their automobiles and trucks, so key suppression men can at all times be in contact with headquarters, dispatchers, and primary lookout towers. A problem with AM radio systems has been interference from rapidly expanding commercial power lines. Conversion from AM to FM, where needed, has been a major activity during the past year or so.

The Forest Service offers the facilities of its radio laboratory at Portland, Oreg., for testing commercial equipment for specification compliance, and for help in solving such technical problems as the State forestry departments may have. Upon request, the Forest Service also extends consultation and advice to individual States on communication problems. It is encouraging the use of standard specifications and quantity purchasing through consolidated orders for the procurement of the most commonly used types of radio equipment, thus assuring good equipment at favorable prices for both Federal and State agencies.

State forestry agencies have been taking an active interest in sectional fire-equipment meetings conducted in cooperation with the Forest Service. Regional fire-equipment development committees have been helpful in reducing unnecessary and costly duplication of effort

in experimenting and in proving equipment. It is the continuing aim of the Forest Service to make available to the States basic information developed through Federal research, and to help the States in every way possible in strengthening their fire-control activities.

Accomplishments During the Past Year

For fiscal year 1950 Congress appropriated \$9,000,000 for Federal cooperation with the States in forest-fire control. This was the ceiling of the legislative authorization then in effect, and it was the third successive year in which the full authorization had been made available. Cooperating States supplied \$20,059,835 of State and private funds for the calendar year 1949, an increase of 18 percent over the preceding year.

The combined funds were applied to the protection of 357 million acres of State and private forest lands. Average cost per acre Nation-wide was slightly more than 8 cents. This does not include additional fire-control activities carried on by many private owners to supplement and strengthen the public protection work handled under the supervision of the State foresters.

The area under organized protection was increased by 17 million acres during 1949. Sixty percent of this increase occurred in the Southern States.

During 1949, 78,649 wild fires on protected State and private lands burned over 2,320,485 acres, or 0.65 percent of the area protected. Generally the fire season was more severe than average. Deficient rainfall from midsummer to December caused unusual emergency conditions in a number of the Gulf and Southeastern States. Conditions were abnormally hazardous also in some of the far Western States.

On the 70 million acres of unprotected land, the number of fires and acreage burned can only be guessed at. The best estimates of State men familiar with these areas place the number of fires at 105,533, and the area burned at 12,760,118 acres, or 15.59 percent of the total unprotected area. On the basis of these estimates, the percentage of area burned would thus be nearly 24 times as high as that on the areas under organized protection.

Tangible damages from fires on protected areas were reported at \$8,003,563. Damage on unprotected areas was estimated at \$32,606,095. Reported damage figures do not take account of indirect losses, such as decay of fire-damaged timber, replacement of valuable trees species by less desirable ones, irregular stream flow, soil deterioration, erosion, and floods, destruction of game and game habitat, interruption of tourist business, and other intangibles difficult or impossible to evaluate. Such indirect losses may often be far greater than the reported damages to timber and property.

The States and the Forest Service in 1950 jointly completed a 5-year periodic revision of estimates of State and private forest area in need of protection and cost of the basic protection job. The over-all estimates showed a total of 426,694,000 acres of non-Federal forest and watershed lands in the United States needing fire protection. Total annual cost of doing a basic protection job was placed at \$48,250,000.

Public Law 392, approved October 26, 1949, authorized increased funds for Federal participation in cooperative forest-fire protection.

The authorization was increased by \$2,000,000 each year to a maximum of \$20,000,000 for fiscal year 1956 and each year thereafter.

Most of the State and private forest land that still lacks organized fire protection is in the Southern States. Extension of protection in these States, however, has been most encouraging during the past few years. South Carolina achieved State-wide coverage in 1947. Georgia enacted legislation in 1949 providing for State-wide protection. Alabama is making rapid progress toward complete protection coverage. Much of this progress can be attributed to the increased value of small-sized timber for pulpwood as a result of expansion of the pulp and paper industry in the South.

A development of far-reaching importance last year was the Northeastern Interstate Forest Fire Protection Compact. Largely an outgrowth of the disastrous Maine forest fires of 1947, this interstate compact was authorized by Congress and has already been ratified by New York and all of the New England States. Its purpose is to promote effective prevention and control of forest fires in the northeastern region of the United States and possibly Canada through development of integrated fire-control plans, maintenance of adequate forest-fire-fighting services by the member States, provision for mutual aid in fighting forest fires, and establishment of a central agency to coordinate the services of the participating States. Development of plans and services under this compact was well under way in 1950.

Legislation enacted in Maine in 1949 provided for strengthening forest-fire control in the organized towns of the southern part of the State. In the northern Maine Forestry District, the rate of taxation for support of forest-fire control was raised.

For Complete Protection

Of the 426,000,000 acres of State and private forest and watershed land in need of protection from fire, about 83 percent (357,000,000 acres) is now under some degree of organized protection. Admittedly, the standards of protection in some of the areas covered are too low, and protection forces and facilities are too thinly spread.

The cost of fire protection, like that of most other things, has gone up. Higher wage rates, increased costs of equipment and other items needed in the protection effort, mean that today's protection dollar buys less in manpower and facilities than the prewar dollar did. The values to be protected, however, also have risen.

Offsetting the increased costs to some extent has been the increased efficiency resulting from mechanization and improved fire-fighting techniques. As expenditures for fire control have gone up, acreage burned has gone down.

The most urgent need is to extend organized protection to the 70,000,000 acres of forest and watershed that are still unprotected. It is these areas that suffer most from wild fires. About two-thirds of the area not yet receiving protection is in the Gulf and Southeastern States, and this includes some of the Nation's most productive forest lands.

Another major need is to raise the standard of fire control where protection is now too thinly scattered.

If forest-fire losses are to be cut to a minimum, additional funds, both State and Federal, are of course a primary requirement. But

additional financing is not everywhere the entire need. In some localities far too many fires occur due to incendiarism or to indifference, and protection efforts there will never be wholly satisfactory until a strong public sentiment against forest fires has been engendered. The obvious remedy in such situations, which are all too common in a number of the Southern States and in portions of other States, is more effective educational work, better fire laws, and more effective law enforcement. General adoption of fence laws in the South, in which there has been some progress, will be a big help in removing the incentive for widespread woods burning.

Logging slash (tree tops and branches left on the ground after logging) continues to be a serious problem confronting State protection agencies, especially in Oregon, Washington, Idaho, and Montana. In these States the usual method of slash disposal is to burn it as soon after logging as this can be safely done. Unfavorable conditions for slash burning, lack of labor during the war, and the reluctance of many operators to burn the slash on their cut-over areas have resulted in accumulations of slash that constitute a serious fire hazard in many areas.

Many large operators believe it to their advantage to provide extra protection on their logging areas instead of burning the debris. Often this is about the only practical measure when the slash is more than 2 or 3 years old, since it is difficult to burn old slash and fire will kill the young seedlings that are usually coming up by that time. The States are well aware of the slash problem and are making headway in solving it. During the past year the slash disposal laws of Idaho and Montana were materially strengthened.

Many forest fires result from brush burning on farms. Landowners start fires to burn trash or get rid of weeds and brush, and their fires get out of control and spread to the woods. A majority of the States now have laws requiring landowners during specified periods to obtain permits before starting fires in or near forest lands. However, too many State protection agencies, especially in the South, are handicapped by lack of such needed fire-control laws. Burning permit laws in these States would be very helpful in fire-control work, but in many instances local public sentiment is not yet strong enough to enact and enforce them.

The fire-control job has been made more difficult in some of the Western States by large areas of dead and damaged trees resulting from recent severe insect infestations. Prompt control of insect outbreaks, therefore, not only can save much valuable timber from being bug-killed but can help in fire control.

Flood surveys are disclosing that in some watersheds the traditional criteria for satisfactory fire control are proving inadequate from the standpoint of flood prevention and soil protection. The resultant action programs will probably call for more intensive protection.

With some unfortunate exceptions, State forestry organizations and activities are not unduly hampered by political interference. Nevertheless in a number of States there is a definite need for civil service and retirement systems, and in many States for higher salary rates, in order to reduce turn-over, provide greater employment security, and build up better morale.

Forest Insects and Diseases

Insects and diseases rank with fire as destroyers of forests. Ordinarily the damage caused by these pests is less conspicuous. But they are at work every year and no forest area is entirely free from them. Their total effect probably exceeds that of fire.

When epidemic stages develop, these pests can do great and spectacular damage. Right now, large areas of our forests in five Western States are threatened by very serious infestations of the spruce budworm and various species of bark beetles. In eastern Oregon alone, about 2¼ million acres of Douglas-fir and white fir forests are infested with spruce budworm which unless soon controlled may kill some 12 billion board feet of timber valued at about \$50,000,000. This insect is reported to have infested 247,000 square miles of Canadian forests in 1945, and periodically it has caused much damage in Maine. It is now invading the Douglas-fir forests in sections of Washington, Idaho, and Montana.

Beetles during the past few years have killed more than 4 billion feet of Engelmann spruce timber in western Colorado, and these and other insects are a potential threat to forests in all the Rocky Mountain States, South Dakota, and California. In 1946 and 1947 epidemic outbreaks of the tussock moth in northern Idaho and of the hemlock looper in Oregon caused damage in limited areas. There are recurring heavy infestations of the gypsy moth in sections of New England, and of the larch sawfly in the Lake States.

Forest tree diseases likewise cause great damage and can even wipe out entire species, as the chestnut blight did. Currently the white pine blister rust is one of the worst forest enemies, and a continued battle is being waged against it. An oak wilt has recently been spreading in the Central States, and the "littleleaf" disease of pines is a serious menace in the South.

In the last 3 years a number of cooperative pest-control projects have been carried on by the Federal Government, the States, and private landowners. Since most of the infested areas in the Western States were in national forests, the major control operations, both for insects and blister rust, have been carried on by the Forest Service with technical advice furnished by the Bureau of Entomology and Plant Quarantine. (Control measures administered on national-forest land during the past year are discussed elsewhere in this report.) Where intermingled or adjoining State and private forest lands are involved, there has generally been a sharing of the costs. Control operations covering mainly non-Federal lands, both in the Eastern and Western States, may be directed by the Bureau of Entomology and Plant Quarantine, with the States and private owners sharing costs, or the State forestry departments may direct the work under technical guidance of BEPQ.

Notable among these during 1949 was the aerial dusting of 160,000 acres of Douglas-fir forests in western Oregon to control the spruce budworm. The project was conducted by the State Board of Forestry. On the national-forest lands involved, the Federal Government paid full costs. On private lands the general cost-sharing pattern was one-half by the State and the other half spread equally between the Federal Government and the private owners.

In the continued fight against the gypsy moth the Massachusetts Department of Conservation in 1949 directed the largest aerial spraying project of its kind ever carried out in the Eastern States. This was a cooperative enterprise between the Federal Government, the State, the county, and the towns, and covered some 229,000 acres of Cape Cod woodlands.

Eight States have laws placing responsibility on the State forestry departments for insect and disease control on non-Federal lands. These are California, Idaho, Maine, Massachusetts, New Hampshire, New York, Oregon, and Pennsylvania. In other States there has been relatively little participation by State forestry departments in actual pest-control operations. Most of these States, however, are interested in doing something about the increasing ravages of forest insects and diseases. Several States are organizing so that all fieldmen will be on the lookout for incipient stages of pest outbreaks, and the information will be reported promptly for appropriate control action. A number of States have entomologists attached to their forestry staffs who function as technical advisers.

The Forest Pest Control Act of July 25, 1947, among other things, authorized the Secretary of Agriculture to cooperate with the States and private landowners in insect and disease control on non-Federal lands. As this act is implemented by appropriations, it is expected that the State forestry departments will be brought more into the pest-control picture than heretofore.

Technical Forestry Services

As early as 1898 the Department of Agriculture's Division of Forestry (which later became the Forest Service) offered the services of technicians to help private forest owners plan their timber harvests so as to obtain successive crops. Even earlier the Department had published bulletins aimed at encouraging good forestry practice. Here and there an owner had been moved to attempt the management of his timberlands in accordance with forestry principles.

Forest Service men continued their efforts to "sell" forestry. Notable among these early evangelists of forestry was Dr. Austin Cary, who for many years traveled around the country, especially in the South, visiting large timber holdings to help the owners work up simple management plans. Only a few of these management plans were actually followed, but the work stimulated much interest in the possibilities of forestry.

Forestry in these early days faced great difficulties. There was still plenty of cheap virgin timber. Lack of adequate fire protection, unstable land or stumpage taxes, fluctuating market demand and prices, and the desire for quick returns from timberlands all tended to discourage planning for long-term operations. Many of the early lumbering operations were designed for rapid cutting of old-growth timber and the sawmill capacity installed was far too large for the sustained-yield possibilities of their supporting timberlands. In some places company properties were so heavily burdened with debt that in times of financial stress the saw literally raced with the accumulation of interest. And the country was not yet conservation-conscious. The concept of stewardship for the land was not part of our philosophy.

Progress Among Large Owners

During the 1920's the forest-products industries enjoyed a boom along with industry in general. Forestry got more attention. A number of companies with large timber holdings employed professionally trained foresters to make management plans. Consulting forester firms sprang up, and found clients among other companies and estate owners.

The depression following the stock market collapse in 1929 was especially severe with respect to forest-products industries, and forestry was set back again. And because the foresters had not yet become an integral part of the organizations they were among the first to go. Many owners of large forest tracts who had prospered during the twenties suddenly considered themselves "land poor." In the depths of the depression many large forest holdings became tax delinquent.

One favorable result of the depression was that some small second-growth trees that had no value at the time were permitted to grow. As a result of this "accidental forestry," owners of second-growth timber, when the business picture brightened, were often delighted to find that the volume and quality of their stands had increased remarkably.

The Lumber Code adopted under the National Industrial Recovery Act of 1933 was important in stimulating interest in improved forest practices. Although the act lasted only 2 years, the efforts of foresters, large landowners, and the forest-products industries were mobilized in an attempt to spread better forest protection and cutting practices. In article X of the Lumber Code, a number of improved practices were agreed to by members of the industry. Even when the act was no longer in effect, the National Lumber Manufacturers Association encouraged its members to continue adherence to the provisions of article X.

Just before World War II industrial forest management made rapid advances. The Federal Government had increased its assistance to forest owners. Research was finding answers to many troublesome problems. The Civilian Conservation Corps had built urgently needed roads and firebreaks, and cooperative fire protection was being constantly extended. A joint congressional committee was established and hearings were held in various parts of the country to determine what could be done to increase the practice of forestry. Industrial corporations began buying land, hiring foresters, and planning for the future. The South made particularly rapid progress, with the big expansion of the pulp and paper industry in that region.

World War II proved that wood is just as essential to victory as steel, aluminum, or coal. Realization of this fact caused a new awakening to the importance of growing timber as a crop. The value of forest products maintained a high level in the postwar years, and more foresters were employed by the large companies. It is estimated that by 1950, about 3,000 professional foresters were in industrial employment, and somewhat more than half of these were engaged, full or part time, in technical forest-management work.

Several national and regional associations of lumbermen and pulp and paper manufacturers are working actively to promote good forest practice. An industry-sponsored "tree farm" program has signed

up many forest owners. Started on the west coast in 1942, this program now operates in 28 States, under sponsorship of American Forest Products Industries, Inc. Participating forest-land owners agree to follow specified forestry practices. On July 1, 1950, American Forest Products Industries reported some 2,500 tree farms, with nearly 21,000,000 acres of woodlands. This is about 6 percent of the country's total private commercial forest land area. In some States, the tree-farm movement could be more effective if the practices required were of higher standard.

Most industrial and other large forest owners are able to employ their own forestry technicians and go ahead on their own in applying sound forest-management practices. Many are doing so. Cutting practices were rated good or better on 29 percent of the operating forest lands in large ownerships in a 1945 survey.

The Forest Service and State forestry agencies continue to offer technical assistance where needed. Research results are made promptly available. The Forest Service provides a small number of forestry specialists in its regional offices, who are called upon to give advice to foresters employed by large landowners and companies, to private consulting foresters, to professors in forestry schools, and to technicians in the State foresters' offices. Assistance is being given especially in such matters as advanced techniques in photogrammetry, improved forest-survey methods, advanced silvicultural practice, forest-management economics, forest-products utilization, development of more efficient machinery, and the development of protection organizations and plans.

On-the-Ground Assistance

The earliest efforts to encourage better forest practice were aimed primarily at large landowners and large sawmill companies. But there are only about 3,600 large owners (with 5,000 acres or more) in the United States, while there are 41¼ million owners with holdings of less than 5,000 acres. These smaller holdings account for 76 percent of all privately owned commercial forest land. Four-fifths of the small ownerships are in tracts of less than 100 acres. The average ownership is 62 acres.

About 3¼ million farmers and 1 million nonfarmers are the owners of these small woodland tracts. The 261 million acres they own are about evenly divided between the two groups—farm and nonfarm. The nonfarm owners include local merchants, country bankers, real-estate men, widows, retired workers, professional men of all kinds. Many of them are absentee owners; many acquired their holdings primarily for speculative purposes; few have been interested in managing their timberlands as a permanent enterprise.

Small woodland holdings have suffered greatly from mismanagement and neglect. Owners have let them be clear-cut to obtain ready cash, often through lump-sum sales of trees to small "grasshopper" mills that light in one place just long enough to chew up the woodland. Many woodlands have been overgrazed to a point where all young tree seedlings were either destroyed or their growth prevented. Uncontrolled wildfires have damaged both young and old growth. Even among those owners who viewed their timber as a crop there has been a general belief that a sale once in a lifetime was

about all that one could expect. Few owners knew how to measure or value forest products; most were at a disadvantage in dealing with timber buyers.

The continued educational efforts of the Forest Service and the State and Extension foresters, cooperative fire protection and tree distribution under the Clarke-McNary Act, work of the Civilian Conservation Corps, agricultural conservation program payments to farmers for forestry practices, the Soil Conservation Service's farm planning and tree planting program, the woodland management work of the Tennessee Valley Authority, and the programs sponsored by the forest-products industries for the promotion of better forestry—all these have helped to give impetus to the application of more forest management to small woodlands, particularly those on farms.

The Norris-Doxey Cooperative Farm Forestry Act of 1937 authorized the Federal Government to cooperate more fully with State forestry agencies, land-grant colleges, and farmers in the regeneration, protection, and management of woodlands, and the utilization and marketing of their products. The war called for huge quantities of wood and its derivatives, the demand for forest products increased, prices were good. Although cutting was disastrous in many small forests, some owners realized for the first time that their woodlands were a potential source of continuous revenue.

A big job lies ahead, however. Good management as yet is being applied to only about 4 percent of the forest lands in small owner-ships. As the small woodlands become increasingly important in supplying the Nation's timber, there is a growing realization that the woodland owner himself can be the most efficient manager and protector of his land, provided that he is aware of the potential value, that he is given public cooperation in forest protection and reforestation, and that in-the-woods technical assistance is available to him when he needs it.

The small-woodland owner is confronted with many technical problems if he is to grow continuous crops of commercially valuable trees without destroying the other useful contributions that his woodland makes—to the conservation of soil and water, flood control, healthful recreation, game propagation, wind regulation, and the like. The average woodland owner needs technical help if he is to market his timber to best advantage; he needs assistance in working up practical management plans. Most small woodlands today are in more or less run-down condition; careful handling is necessary to build up the growing stock. Because forests vary greatly in species, age, type, and condition each woodland is an individual problem. General rules of thumb are not enough.

Farm Foresters

Some 220 technically trained foresters last year were giving on-the-ground assistance to small-woodland owners. They were employed on Federal-State cooperative projects under the Norris-Doxey Act. The Forest Service administers the Federal part of the program and shares in the cost; the cooperating State forestry agencies employ the project foresters and supervise their work. Generally known as the farm forester or the "local forester," the Norris-Doxey project forester works with farmers, local agricultural technicians,

small-sawmill operators, and others to help solve forest-management problems in his community.

Upon receiving a request for assistance, the farm forester visits the woodland in company with the owner and advises as to what the woodland needs in the way of management. He may make up a simple management plan, help mark trees to be cut, and advise on marketing the products. Or he may recommend against cutting young timber that will yield the owner far more if allowed to grow a few years. If the job warrants employment of private consultants, he recommends qualified consulting foresters.

Since the program started in 1940 more than 100,000 small-woodland owners have been given such in-the-woods assistance on a total of 10 $\frac{3}{4}$ million acres of woodland. This is only a small fraction of the more than 4 million woodland owners; but from the woodlands served about 3 $\frac{1}{4}$ billion board feet of timber and additional quantities of naval stores, maple sirup, and other forest products have been harvested with the farm forester's advice. The owners received \$48,350,000 for products sold. Much lumber, fuel wood, and other products were also used on the farms. Many of these woodlands are now producing regular timber crops at intervals of 1 to 10 years.

The Norris-Doxey project foresters are getting many more requests for service than they can handle. At the end of fiscal year 1950, more than 4,500 requests for assistance remained unfilled.

About 1,000 counties are included in the project areas now served; many of the foresters are attempting to cover 3 to 5 counties. More farm foresters are needed to cover adequately the counties now included in the project areas. Another 1,000 counties with substantial areas of woodland in small ownerships still lack any such cooperative service, and should be incorporated into project areas.

The small forest properties are the most accessible and potentially the most productive forest lands in the country. Today they are generally in the poorest condition. Few owners of small woodlands, farm and nonfarm, have the technical knowledge necessary to manage their timber for maximum, sustained production. Many are uninterested in forestry. Many are not aware of the returns that come from good forest management until the possibilities are pointed out to them.

Educational programs and demonstrations are stimulating a desire on the part of more and more woodland owners to give forest management a trial. On-the-ground technical assistance to the individual landowner will help in getting improved management practices actually applied in the woods.

Education in Farm Woodland Management

Agricultural leaders are recognizing more and more the economic importance of the 139 million acres of commercial forest land owned by farmers. There is a tremendous job to be done, however, in bringing home to all of the 3 $\frac{1}{4}$ million owners of farm woodlands the need for and advantages of good forest management. Cooperative extension work in forestry is helping to bring about an awakening to this need.

Forestry extension work as a joint responsibility of the Department of Agriculture and the State agricultural colleges came as a

natural development within the land-grant college system. Soon after Congress passed the first Morrill Act in 1862, land-grant colleges were established with a broad authorization "to teach such branches of learning as are related to agriculture and the mechanical arts." The techniques of agricultural production received first attention. Research came along later as a supporting factor. Farmers' institutes were one of the first large-scale efforts to provide information on agricultural practices to farm people. These institutes helped lay the foundation for a more effective system of popular education outside the colleges which came to be known as agricultural extension work.

Some attention undoubtedly was given to farm forestry in this early agricultural extension work. Michigan Agricultural College in 1912 was giving information through its extension division to farmers who wished to plant cut-over lands to trees. The New York Extension Service was getting requests for information from farmers who desired to improve conditions in their second-growth woodlands.

But it was not until 1914, when the Smith-Lever Act authorized Federal-State cooperation in establishing systematic, large-scale agricultural extension work, that forestry was regularly included in extension programs. New York in 1914 set up a formal extension project in cooperation with the United States Department of Agriculture to provide forestry information to farmers. Tennessee followed suit in 1915, after having requested the Forest Service to assist in determining the farm woodland situation and the need for forestry work. This led to the first farm-forestry demonstration in the South, which was conducted by W. R. Mattoon of the Forest Service, and the local county agent. Mr. Mattoon, assigned to extension work by the Forest Service, played an important part in the early progress of farm-forestry extension work. By 1924, 10 State extension services had active programs in farm forestry in cooperation with the Department of Agriculture.

The Clarke-McNary Act of 1924 provided a big stimulus to farm-forestry extension work. Section 5 of this act gave specific authorization for Federal cooperation in forestry extension and for making funds available to the States for this work. In carrying out the provisions of section 5, the Department of Agriculture designated the Forest Service as the subject-matter authority and the Extension Service as the agency for channeling or extending forestry information and educational assistance to farmers.

Within 2 years after passage of the Clarke-McNary Act 26 States had organized farm-forestry extension projects in cooperation with the Department. Forestry-trained men were employed to head up the State programs, which included demonstrations and the use of the various informational media and teaching devices employed by the agricultural extension services. With the leadership of forestry-extension specialists, county agents began to include forestry in their plans and to urge farm owners to protect and manage their woodlands and put their idle lands to work growing crops of timber.

Further impetus came with the passage of the Norris-Doxey Cooperative Farm Forestry Act of 1937. Farm forestry entered a new period of development through the availability of increased funds for extension forestry, production of tree planting stock, technical assist-

ance to owners, and farm-forestry research. State programs calling for cooperation of forestry agencies were prepared.

With a better appreciation by State agencies of their mutual interest in farm forestry came a desire to clarify the fields of responsibility. This resulted in a policy statement approved in 1948 by the Association of State Foresters and the Land Grant College Association. This statement outlines a working relationship between State forestry departments and the State extension services. Federal-State cooperation in educational work as conducted by the extension services and technical service assistance by the State forestry departments are being brought together in developing better coordinated forestry programs in the States.

Public Law 392, enacted in 1949, authorized increased Federal funds for cooperative extension work in forestry. The Department of Agriculture is now cooperating with 46 States and Puerto Rico in farm forestry extension programs under the Clarke-McNary and Norris-Doxey Cooperative Farm Forestry Acts. Funds allotted to the States are more than matched by funds from State sources and are used for the employment of extension foresters. Last year 68 extension foresters in the cooperating States developed extension programs and carried them out through the county agricultural agents and in cooperation with other State and Federal agencies. Two extension foresters are employed by the Federal Extension Service to assist the States with their farm forestry programs and to serve in a liaison capacity between the Department of Agriculture and the States, giving special attention to subject matter, extension methods, and cooperative procedures.

The number of farmers provided with information on timber estimating, marketing, tree planting, windbreak and shelterbelt establishment, forest-fire prevention, treatment of fence posts with preservatives, and other phases of woodland management and utilization of farm timber has increased steadily. Thousands of 4-H Club members are carrying on forestry projects, and other thousands are receiving instruction in forestry matters at club meetings and camps. This reflects a growing interest on the part of county agents and 4-H Club leaders who feel that farm youth should have a better understanding of the forest resources on the farms.

Although much progress has been made, the needs for this work are far from being met. A great deal more educational work, as well as direct on-the-ground technical aid, needs to be done.

Naval Stores

The deep South region of the United States is the world's greatest producer of naval stores, and naval stores production is one of the important industries of the Southern States. Naval stores (turpentine and rosin) are valuable forest products, used in paints, varnishes, soaps, and hundreds of other useful commodities and manufacturing processes.

Turpentine and rosin are produced commercially by two different methods. Gum naval stores are obtained by distillation of the resinous "gum" which exudes from longleaf and slash pine trees when their bark is chipped or streaked. Wood naval stores are obtained by processing chips from old-growth pine stumps, and as a byproduct

from sulfate pulp mills. Until about 1912, 99 percent of the turpentine and rosin produced in the United States was from gum production. Wood naval stores production continued to gain, however, until in 1949 52 percent of the production was from wood. Eventually the supply of old-growth stumps will decrease. Gum naval stores production can continue, however, as long as the pine forests are kept growing.

Fifty years ago, gum naval stores were produced in the southern coastal States by methods that differed little from those first used in 1606, when chipping trees to produce pitch and tar for the British Navy was first started in the Western Hemisphere at Nova Scotia. The trees were streaked deeply with a curved hack, and the oleoresin or "gum" was collected in a hollowed-out depression, called a "box," chopped into the base of the tree. As the large old-growth timber disappeared it became apparent that some new method must be devised that would be less destructive to small second-growth timber than the wasteful "boxing" of trees. The first notable improvement occurred in 1902, when W. W. Ashe and Dr. Charles H. Herty of the Forest Service introduced the cup-and-gutter system. This new method made possible the working of smaller trees, and the trees could be chipped to a greater height, because the cups and gutters could be moved up each year as the face height increased.

In 1921 the Forest Service established the Southern Forest Experiment Station, and soon afterward a branch station was placed at Starke, Fla., later moved to Olustee, to engage in research on naval-stores problems. In 1928 the Osceola National Forest was established in Florida, one of its purposes being to demonstrate on a large scale the practices developed through research.

Experiments in the use of chemicals to increase and prolong the flow of gum were started on a small scale at Olustee in 1936. In the new technique eventually developed, a one-half inch strip is removed from the tree instead of the old system of chipping deeply into the wood. Gum flow is prolonged by the application of an acid solution so that chipping at 2-week intervals gives as much production as weekly chipping with the old system. Chemical stimulation is now out of the experimental stage and has been adopted by more than 400 producers.

Other experiments carried out at the station have resulted in the development of a gasoline-powered back-pack chipper and a curved gutter to fit the round face resulting from shallower bark chipping. Tests have shown that there is a saving in labor costs when larger cups are used, with no appreciable loss from evaporation. Plastic-coated disposable paper cups are being tried out and indications are that they not only will save time in dipping but may materially reduce the number of dippings required during a season.

Many improvements have been made in the methods of processing gum naval stores. In 1925 there were 2,500 stills in the naval stores region. By 1949 less than 100 of these old-style copper "pot" stills were in operation. The first modern gum-processing plant was built in 1934. In 1949, 30 of these plants were operating at convenient points throughout the naval stores belt.

Agricultural Conservation Program

The Soil Conservation and Domestic Allotment Act of 1936 provided for conservation payments to producers of gum naval stores in the seaboard States, North Carolina to Texas, inclusive. Under this act, a naval stores conservation program is administered by the Forest Service for the Production and Marketing Administration of the Department of Agriculture.

The 1937 and 1938 programs provided payments for the removal of cups and tins from undersized trees. Other requirements had to do with the depth and width of streaks and the height of faces, and the producer, to be eligible, also had to cooperate with State forest-fire protection units in his area. Restrictions on timber cutting were introduced in the 1938 program and have been revised and strengthened during the years the program has been in operation. The requirements as to height and depth of streaks and maximum yearly height of faces gradually were eliminated in later years as producers adopted more conservative working practices. Payments for taking undersized trees out of production were discontinued in 1945.

The 1939, 1940, and 1941 programs, in addition to the conservation features, provided payments for crop reduction. Since 1942 the program has been based entirely on good naval stores practice with the objective of growing larger trees and more trees per acre for all wood-using industries throughout the 50 million acres of the naval stores belt.

The total number of producers of gum naval stores has varied from an estimated 12,000 in 1936 to a listed 8,279 in 1949. These producers worked from 60 million to 120 million faces yearly during this period. In 1937, 671 producers participated in the conservation program. Last year the number participating was 2,451.

During the period of the program there has been a marked improvement in naval stores practices. In 1935, 30 percent of the faces in the naval stores region were on trees less than 9 inches in diameter. In 1950 less than 1 percent of the faces were on trees less than 9 inches. One indication of accomplishment in saving these smaller trees for more productive later use is that the average number of faces per acre has increased from 16 in 1935 to 27 in 1950. Availability of larger trees permits having more faces per acre.

Continuing efforts have been made to persuade small gum farmers to participate in the program. In many cases, however, because of the small number of faces they work, participation would mean too much of a loss in their production of gum. Nevertheless, the 1949 participation represented 85 percent of the total gum production.

The 1949 program was designed to encourage better land utilization and conservation by making higher payments for the better practices. For example, payments of 5 cents per face were made for selective cupping (leaving as many round trees of the same diameter as those cupped), and 4 cents per face for cupping only those trees that were 11 inches or over in diameter. In contrast to these payments, only 2 cents was paid for 9-inch (minimum) diameter cupping, and ½ cent for continuation of this practice on second-, third-, and fourth-year faces, with no payment for older faces.

Tree Planting

Millions of acres of good forest land have been so denuded by fires or destructive cutting that if they are to be made productive again within a reasonable time they must be artificially reforested—i. e., replanted to trees. Many lands that have been cleared for farming proved to be such poor croplands that they also might better be put back to timber growing. For flood control, erosion prevention, and protection of water supplies, reforestation is a "must" on many critical watershed areas.

The Forest Service is reforesting old burns and other denuded areas within the national forests as available funds permit. It is also cooperating with the States in programs to encourage and facilitate tree planting on private lands. One way to get planting done by private landowners is to make planting stock available at a low cost. That is what is being done in the Federal-State cooperative program now carried on under the Clarke-McNary Act.

Growth of the Tree Planting Movement

It can probably be said that reforestation of cleared land began almost as soon as the clearing of the land. There are records of oak plantings for ship-timber production in the 1740's. George Washington wrote frequently in his diary of his tree-planting operations at Mount Vernon. Many folks in New England, New York, Pennsylvania, and elsewhere were planting pines, chestnuts, etc., in the early 1800's. All these early plantings, however, probably covered only a few thousand acres.

When the prairie States were opened to settlement, most of the early settlers on the treeless plains came from forested regions to the east. They felt a desperate need for trees. Trees often shared with a garden the first patch of sod broken by the plow. Kansas in 1865 passed a tree bounty law in an effort to get tree planting started. Four years later Nebraska and the Dakota Territory passed tax-exemption laws to favor tree planting. Arbor Day originated in Nebraska in 1872, and the idea gradually spread over the whole United States (and to many other countries, for that matter). Congress in 1873 passed the Timber Culture Act which offered land free to settlers who would plant 40 acres to trees (later reduced to 10) on each 160-acre claim. It has been estimated that 2,000,000 acres in the prairie States were planted as a result of this act. Many settlers, however, planted trees poorly suited to the region; many of the plantings were neglected and died. Perhaps not more than 50,000 acres of the tree plantations were successful.

Around 1900, planting work got under way on State and national forests then being established. Probably less than 1,000 acres were planted in that year. But each year a few more acres were planted than the year before. On private lands, most planting was being done as a hobby, or for sentimental or esthetic reasons. But there were a few who were reforesting in expectation of commercial returns in the foreseeable future. Some of these commercial plantations are now being harvested.

Public Aid in Reforestation

With the passage of the Clarke-McNary Act of 1924, cooperative public aid to farmers in tree planting got under way. Section 4 of

that act authorized the Department of Agriculture to cooperate with the various States in the procurement, production, and distribution of forest-tree seeds and plants for the purpose of establishing wind-breaks, shelter belts, and farm woodlots upon denuded or nonforested lands. The act authorized Federal contributions equal to those of the States. From the beginning, however, the contributions by the States exceeded those of the Federal Government by severalfold.

In 1926, the first full year of the cooperative program, 28 States participated, and distributed a total of 44 million trees. Last year 41 States and 2 Territories were cooperating in the program; 103 million trees were distributed to farmers. The States grow the trees in nurseries of their own, or buy them from commercial or Federal nurseries, and sell them to the landowners at a low price, usually less than cost. The loss is made up by State and Federal funds.

The Clarke-McNary Act, and the Norris-Doxey Act of 1937 which provided additional authorizations for cooperative tree-planting work, restricted such help to farmers only. States that furnished trees to nonfarm landowners could expect no Federal aid toward the cost of those trees. Nevertheless, many of the States went ahead without Federal help and grew trees for distribution to nonfarm owners. New York and Pennsylvania, for example, have had tree-production programs for nonfarm planting nearly as big as their Clarke-McNary and Norris-Doxey programs. Last year Congress amended the Clarke-McNary Act to remove the farmer limitation, a step long advocated by conservation agencies, since large areas in nonfarm ownership are equally in need of reforestation.

Other Cooperative Programs

During the 1930's two programs began that gave a great stimulus to tree-planting interest. These were the Civilian Conservation Corps program and the shelter-belt project.

With the planting manpower provided by the CCC, millions of trees from existing nurseries were set out, and many new nurseries were established to produce trees at an increased rate. The CCC planted some 2 billion trees on 1,862,000 acres during the years from its beginning in 1933 to its end in 1942.

The shelter-belt project, formally known as the Prairie States Forestry Project, was started in 1934, a time of serious drought, dust storms, and depression. Its purpose was to aid farmers in establishing shelter belts to protect their fields from the damaging effects of winds, and at the same time to provide work for unemployed people in the drought-stricken Great Plains. The project was directed by the Forest Service, which furnished the trees and conducted the planting operations. Cooperating farmers agreed to fence, cultivate, and maintain the tree belts. Between 1935 and 1942, 18,510 miles of field shelter belts, not counting many smaller plantings to protect farm homes, yards, and gardens, were planted by the Forest Service. The Soil Conservation Service (to which the work was transferred in 1942) planted an additional 8,363 miles between 1934 and 1949 in its program on soil-conservation districts.

Other shelter-belt plantings also have been under way. The Wisconsin State Conservation Department furnished planting stock and, with the Extension Service, was responsible for establishing 5,942 miles of shelter belts. In California fruit-tree growers have planted 2,000

miles of belts to protect citrus orchards and vineyards. In Indiana truck gardeners have planted 100 miles of tree belts on muck land. Many more miles of shelter belts for which no published records are available probably have been planted in other States.

Several other Government agencies have helped to encourage private-land owners to plant trees. The Production and Marketing Administration, as a part of its agricultural conservation program, offers financial assistance to farmers who cooperate by planting trees. The Soil Conservation Service has obtained acceptance of tree planting as good practice on farms in most of the 2,145 soil conservation districts. Some soil conservation districts are now operating their own tree nurseries, and others contemplate establishing them. The Tennessee Valley Authority also has done much to stimulate tree planting in its area of operation. Private-land owners receive trees from TVA nurseries, and thousands of acres have been planted.

All in all, these Federal Government and State government assisted programs, together with unassisted activities by many private-land owners, gradually built up tree planting on private land to a rate of a quarter million acres annually in the years just before World War II. By the start of the war, it was reported that the total private land area planted in the United States since records began was close to 2 million acres, of which about three-fourths was classed as successful. But in spite of all this increased reforestation, the area of land in need of planting had been increasing at a greater rate than the area planted.

World War II and After

When the war started, planting dropped to a low rate. Many State and Federal nurseries were shut down, as well as many of those operated by private landowning companies. Production in State nurseries in 1944 was less than in 1926, when the Clarke-McNary work began.

Since the war, tree planting efforts have been expanding. New nurseries have been built, old ones reopened or enlarged, and capacities increased. Forty-one States now have State nurseries. Their 1949 output was almost 230 million trees; their 1950 output was expected to exceed 300 million. TVA and SCS nurseries are again producing large numbers of trees.

Along with this renewed activity in producing trees, increased attention is being given to instruction in tree planting. County agents, 4-H Clubs, Future Farmers groups, civic clubs, garden clubs, lumber and paper companies, and others are giving demonstrations. Tree-planting machines have been developed that can greatly speed up planting on many locations. Some of these machines are loaned free of charge to landowners by States, railroads, and forest industries. Some are being purchased cooperatively by local groups.

Forest industries are sponsoring a number of programs to encourage tree planting. A group of pulp and paper companies in Wisconsin conducts a Trees for Tomorrow program and is doing a great deal to stimulate reforestation in that State. An association of southern pulp and paper producers is distributing thousands of trees free of charge. A lumbermen's association in the Pacific Northwest operates a large tree nursery for its members, and a number of individual companies operate smaller nurseries of their own, or are getting planting stock from State nurseries. An association of commercial nurserymen has

started a "Plant America" campaign intended to help stimulate planting.

An important development of the year was the enactment by the Oregon State Legislature of the Oregon Forest Rehabilitation Act. This act authorizes the State forester to rehabilitate, reforest, and develop the vast Tillamook burn area in the northwest corner of Oregon. A heavily timbered area of more than a quarter of a million acres burned over in 1933 in one of the biggest forest fires of recent times. The same area was ravaged to a large extent by subsequent fires in 1939 and 1945. The rehabilitation program calls for ultimate expenditure of about \$10,000,000. A huge task of tree planting and seeding is involved, as well as intensified fire protection which will require the felling of millions of standing dead trees.

Millions of Acres Need Planting

The reappraisal of the forest situation made by the Forest Service after World War II showed a total of 75 million acres of commercial forest land in poorly stocked or denuded condition. Nearly 62 million acres of this is in private ownership. Some of this land will come back to useful tree growth naturally within a few decades. But much of it will have to be planted; otherwise it will remain unproductive for a great many years. In addition there are many areas of noncommercial forest land and other denuded and eroding wild lands that should be planted to trees for watershed protection. All told, it has been estimated that at least 60 million acres of privately owned forest land in the United States need planting. Some State foresters believe the total is nearer 100 million acres.

In any event, there is no question but that a huge amount of land should be reforested. And additional land now forested will undoubtedly become denuded. Even the planting of 500,000 acres a year by all agencies, public and private—the rate achieved just before the war and about to be reached again—is insignificant in comparison with the area to be planted. As this rate it would take something like 120 years to cover the minimum estimate of area in need of planting.

Tree planting at double that rate—at a rate of a billion trees a year on a million acres by all agencies combined—is suggested as a reasonable goal. Last year Congress took an important step toward making the attainment of such a goal possible by raising the annual authorization for Federal cooperation with the States under section 4 of the Clarke-McNary Act from \$100,000 to \$2,500,000. The total cooperative tree-planting appropriation for fiscal year 1950 was increased by \$100,000 to a total of \$224,600.

Before the million-acres-a-year goal can be reached, more nurseries will be needed. A number of these are already well along in the planning stage. Some will be Federal, some industry nurseries, but the majority will be State nurseries. Increased use of tree-planting machines will help to speed the work. "Custom planting" of trees by forest consultants and contractors with planting machines is beginning. More follow-up on reforestation operations by planting experts, to see how and why the work succeeded or failed, should pay off well in increased rates of survival and prevention of mistakes in planting unsuitable sites and species.

Research is pointing the way to another step that will improve the final crop, if not the rate of planting, and that is the growing of trees

from seeds of superior parentage—"tailor-made" for the specific site or purpose, so to speak.

Additional research probably will also lead to greater success in direct seeding on the ground. Attempts at direct seeding in the past have seldom been successful—rodents or birds usually consumed most of the seed, germination of seed was poor, or survival of seedlings was low. But recent experiments have indicated new possibilities, at least under certain conditions.

State and Community Forests

During the past decade, the area of State forests and parks increased by some 4 million acres. In 1949 the total was 14,848,000 acres.

Some of the States have gone much further than others in the development of State forests. In fact, four of the States now have about three-fourths of all the State forest acreage. Michigan has a total of 3,860,000 acres. New York's State forests and parks together total 3,026,000 acres. Minnesota reports 2,094,000 acres, and Pennsylvania 1,767,000 in State forests and parks. Every State now has at least some forest acreage, although some States have very small amounts.

In the early days there was generally more interest in getting publicly owned lands into private ownership for exploitation than in the reverse of this process. A positive State forestry program, and especially a program of State ownership of forest land, often did not develop until a State had more or less gone "through the wringer" of forest depletion. Before State forests could be established there had to be legislation making legal such ownership and providing for administration of the lands. Action providing these things at least in some degree was taken by California, Colorado, Ohio, and New York in 1885, followed by half a dozen other States before 1900.

State forests have been established in a number of States by means of purchase programs. Some acquired substantial areas of cut-over and burned-over land through tax delinquency. The States had to take over the land that no one else wanted. They now have the problem of making these lands again productive.

Programs of the Federal Government also have resulted in some lands going into State forests. One of these was the former Resettlement Administration program of buying tracts of submarginal farm land and retiring it from agricultural use. Many of these old farm lands are now reforested, and although federally owned are leased to the States and generally managed as a part of the State forest systems.

The 48 States now report 2,263 separate tracts of State forest and State park land. These lands are being managed to serve a variety of purposes. Some areas, and especially the smaller ones, are devoted wholly to recreational use. Some are hunting grounds. In some, watershed protection is paramount, while still others are managed for timber production. Most of them, however, are managed for all of these purposes—that is, they are administered on a multiple-use basis, like the national forests.

In many of the States, the State forest lands are now well administered; they are being given protection and management for per-

manent production and service, and they are making an important contribution to the advancement of forest conservation in this country. In a few States, however, the practices followed still leave much to be desired.

Community-Owned Forests

The same reasons that led to the development of State forests have brought about the establishment of many public forests by counties, municipalities, and other local units of government. The number of such community forests has increased notably during the past decade.

The idea of local public forests, however, is not new. The town of Newington, N. H., has owned a forest since 1710, and for nearly 2½ centuries this town forest has played an important part in the life of the community. It furnished materials to help build the village church, parsonage, town hall, school, and library. In later years it has furnished planks and timbers for bridges and similar improvements, and in some years fuel for public buildings. Although Newington's was one of the earliest, if not the first, in this country, a number of other town forests in New England date back to colonial days.

Outside of New England, few such community forests were established before 1900. But with the growth of the conservation movement during the next few decades the idea began to take root elsewhere. Public sentiment favorable to the creation and operation of community forests of one sort or another resulted in the enactment of State laws sanctioning their establishment in a number of States. By 1938, incomplete reports showed that about 1,500 community forests had been established in the United States, comprising all together about 3,000,000 acres.

In 1949 the number had risen to 3,125 and the aggregate area to just under 4,500,000 acres. Only 5 States still have no community forests, although 22 States have less than 10 each. At the top end of the scale are Wisconsin with 321 tracts covering almost 2,400,000 acres, Michigan with 846 tracts covering 165,000 acres, and New York with 658 tracts and 150,000 acres.

Community forests are usually, although not always, smaller in size than State forests. They are generally managed for similar purposes. Many are devoted primarily to recreational use. Some are managed for timber production, and some are under multiple-purpose management. Many schools or school districts have acquired forest tracts to serve as outdoor laboratories for the study of biology and conservation. Cities often buy extensive areas to protect the sources of their municipal water supplies. One of the best known of these municipal watershed forests, by virtue of its large size and profitable management, is the Cedar Creek watershed owned by the city of Seattle. The city began acquisition of this watershed in 1900 and now owns over 66,000 acres. Sustained-yield logging is carried on in the forest without impairment of the watershed values. Timber harvested from it has paid back the original cost.

Since the war, many communities have acquired tracts, by purchase or through donation, and have established community forests as living memorials to those who lost their lives in the war.

The Forest Service has encouraged the development of community forests. For a number of years a member of the Forest Service has been assigned part-time to serve as a consultant with States and local

communities on procedures for establishing them and on plans for their management.

Research Aids Advancement of Private Forestry

In the organizational set-up of the Forest Service, research is conducted in a separate branch from that which handles the cooperative action programs with the States and with private forest owners. The technical knowledge developed through research, however, is basic to all these programs. It is the foundation on which the advancement of forestry depends.

Many of the research projects in which the Forest Service is engaged are cooperative endeavors. Last year 644 cooperative agreements for the conduct of research were in effect between the Forest Service and non-Federal agencies. Over half (364) of these cooperative agreements were with industrial concerns. One hundred twenty-five were with State agencies; 82 with State agricultural experiment stations, and 73 with private institutions and colleges. These agreements involve active partnership by the State or private agency and cooperative participation in the joint research undertaking.

Not many forest owners or forest industry concerns can individually finance intensive or long-term research projects—least of all the four million-odd small woodland owners and 50,000 small sawmills that depend on these woodlands for raw materials. In the national interest, nevertheless, the best possible scientific methods should be applied on private as well as public woodlands, large and small. Any lack of continuous yields from these forest lands will affect the Nation's timber supply; mismanagement of these lands can be detrimental to national welfare in many other ways. Forest research therefore becomes, in large measure, a public responsibility. Congress recognized this in the McSweeney-McNary Forest Research Act of 1928, which provided a broad charter for a forest-research program in the United States applicable to private forest lands as well as public lands.

Although the responsibility of the Forest Service to provide leadership in forest research is inescapable, and is definitely assigned by mandate of Congress, close cooperation and coordination with the research and action programs of other public agencies, with the States, industry, and private institutions is essential to continued progress. Such cooperation is in effect and is producing results.

Research in forest fire control, silviculture, soil and water problems, and other phases of forestry is contributing to better forest and range management both on public and private lands. Information developed through the Forest Survey and other forest-economics studies is of value to the forest industries in planning new plant locations, long-term production schedules, and in many other ways. Forest-products investigations have made possible large savings for manufacturers and shippers, development of new industries, and new and better products for consumers.

Special problems of the small woodland owner get attention, too, in the research program. Investigations in marketing of small woodland products are under way. Several Forest Service experiment stations are conducting studies in farm forestry. The Crossett Research Center in Arkansas, for example, has a "Farm Forty"—a 40-acre tract

that is handled as a farm woodland to determine how to get maximum continuing returns.

In 1949, the total expenditures for forest research in the United States were approximately \$16.9 million. Some \$5 million of this was Federal appropriations for use by the Forest Service. About \$4 million was appropriated by State agencies, \$2½ million by private institutions and colleges, and \$5⅓ million by industrial corporations. Nearly 30 percent of these non-Federal funds were spent on research in direct cooperation with the Forest Service, and a large part of the remainder was closely coordinated with the Federal program. These facts point to the effect of the national and regional Federal research efforts in stimulating non-Federal research to solve local and individual problems. There is every indication that continuation of an aggressive Federal program of regional research will further stimulate such local efforts.

All this work is contributing to the basic knowledge needed for better management of our forest lands and more efficient utilization of their products. Forestry is still a relatively new science in America. There must be continued progress, stimulated by broad vision, to keep forestry abreast of changing conditions and needs. Not only must research find the answers to many forest management questions, but the information must be placed in the hands of the woodland owners and managers who need it and can put it to work.

Many Are Helping

A notable increase of interest in forest conservation has occurred in recent years. Fifty years of earnest educational effort by the Forest Service and cooperating agencies undoubtedly has had some effect. The tremendous demands for forest products during World War II, domestic needs for postwar housing and for repair of buildings and structures that deteriorated during the war, new uses of wood in plastics and other synthetics, the realization by large industrial groups and trade associations that productive woodlands are necessary for continuous operations—these things also have contributed to a greater awareness of the place of well-managed forests in the economy of the Nation.

Increased recreational use of the forests, the demand for more fish and game by more fishermen and hunters, and awakening interest in problems of water supply, flood control, and soil conservation are other things that have led to a growing appreciation of the value of forests.

Numerous service clubs, civic organizations, veteran's groups, sportsmen's organizations, garden clubs, women's organizations, young folks' organizations, and church groups are now actively interested in forest conservation. Many have hard-working, well-informed conservation committees and are participating in or supporting national or local forest-conservation activities. The Chamber of Commerce of the United States and the Junior Chamber of Commerce of America have conservation departments. The American Forestry Association, Izaak Walton League of America, Friends of the Land, and other national and local conservation organizations are active in the promotion of forestry measures. State forestry associations, composed of

woodland owners, foresters, and public-spirited citizens often spearhead forestry activities within their particular States.

The American Bankers' Association, through its agricultural commission's forestry committee, is working with State bankers' associations to support forestry programs. A private bank in Louisiana has established a demonstration forest to encourage reforestation in its local parish. It also owns a mechanical tree planter which it lends to local landowners without charge. Some small-town banks make what amounts to supervised loans on small woodland properties.

Industrial groups and associations have been concerned with forestry work. In 1920 the National Lumber Manufacturers Association set up a forestry committee. The conservation department of the Southern Pine Association was established in 1934; and in the same year the West Coast Lumbermen's Association and the Pacific Northwest Loggers' Association joined in setting up a conservation committee. In 1935 the California Redwood Association became interested in improved forest practices. The American Pulp and Paper Association formed a forestry committee in 1938. The Southern Pulpwood Conservation Association was organized in 1939 by southern pulp and paper companies, and is doing especially effective work. All of these groups have been working to get good forestry practices in effect on member companies' lands, and in many cases also to encourage better practice on the part of other woodland owners.

American Forest Products Industries, Inc., started by the National Lumber Manufacturers' Association in 1941 and reorganized independently in 1946, is sponsoring the "tree farms" campaign and other forestry activities. The American Walnut Manufacturers' Association in 1944 employed a forester to encourage the growth of walnut trees in specific areas, and has cooperated with the Forest Service in publishing informational material for woodland owners. A joint cedar forestry program is being conducted by the Aromatic Red Cedar Association and the National Cedar Chest Association. In 1945 the Appalachian Hardwood Manufacturers, Inc., started a forestry program.

More than 20 American railroads now employ foresters to promote better forest practice in the areas they serve.

Among Federal agencies, several are helping to promote good forestry on private lands. The Soil Conservation Service encourages and assists in tree planting and woodland management through technicians assigned to the soil conservation districts. The Production and Marketing Administration makes conservation payments to farmers for tree planting, timber stand improvement, maintenance of firebreaks, certain naval stores operations, and other good management practices. The Federal Aid to Wildlife Restoration Branch of the Fish and Wildlife Service, operating under the Pittman-Robertson Act, is aiding farmers in the establishment of plantations of trees and shrubs for improved wildlife habitat.

Many of the activities of the State forestry departments and State agricultural extension services already have been mentioned. Other State agencies such as the State park services and fish and game commissions are interested in the application of good forest management by the private landowner because of the beneficial effects on recreation, wildlife, and other resource-dependent activities. In addition many

county governments are now interested in seeing a better brand of forestry practiced on private lands. The tax base is improved and business and income in the community generally is better when the woodlands are productive.

A plentiful supply of graduates is now coming from the forestry schools and is available to give technical guidance to an expanding program of forestry. During the past year approximately 7,500 students were enrolled in forestry schools, and some 1,650 degrees were conferred. Inasmuch as Federal agencies probably did not recruit more than 100 junior professionals in the forestry and range fields, some 1,500 graduates were available for technical work in State and private forestry.

All these things together inevitably have resulted in more actual forestry practice on private land. In the 50 years since forestry in America began to gain some recognition, an encouraging start has been made toward its general application. Eight percent of the privately owned commercial forest land is now well managed, and on an additional 28 percent the cutting practices are rated at least fair.

But the fact remains that some 64 percent of all timber cutting on private lands is still poor or destructive. Notable progress has indeed been made, but in view of the total job to be done there clearly is no ground for complacency.

FOR THE FUTURE

In spite of all the gains in forestry that have been made over the years, we have yet to stop the downward trend of our forest resources in the United States. Saw timber is being taken from the forest faster than it is being replaced by growth. The quality of the timber growth is deteriorating over large areas. On the commercial forest lands of the country, timber growth on the average is only about half of what the land could and should produce.

As noted earlier, the forest reappraisal made by the Forest Service in 1945-46 showed that 64 percent of all timber cutting on private lands was still poor or destructive. On only 8 percent was the cutting up to really good forestry standards. Improved practice may have been applied on additional forest lands since this management-status survey was made in 1945. But so large is the total acreage involved that even if such improvement extended over several million acres it would not greatly alter the over-all picture. Until poor and destructive cutting becomes the exception, and good management is much more widely prevalent, the over-all situation cannot be considered satisfactory.

The most significant progress in private forest management has taken place on the large industrial holdings. Compared with the 8 percent of good or better cutting practice for all private forest lands, large holdings showed good or high-order cutting practice on 29 percent of the operating acreage in the 1945 survey. There are factors favorable to continued progress: The present high rate of industrial production and generally good business conditions; the strong demand for all kinds of forest products at good prices; improved systems of taxation of forest land in a number of States; new

uses for wood and its derivatives and improved practices in milling and processing which make possible the reduction of waste and the marketing of byproducts; mechanical aids, such as power saws and better skidding and hauling equipment, that reduce labor requirements; and increased assistance from public agencies in protecting the forest from fire, insects, and diseases.

These factors make for a situation favorable for practicing forestry, for those owners who wish to do so. But some of these things also make destructive cutting currently profitable. Many owners are cashing in on their timber holdings while they are sure the returns will be high. Present profits mean more to them than sustained future income. It is perhaps not an American characteristic to take many long looks into the future.

Some other conditions also work against the progress of private forestry, though these may be overlooked in times of good business. Among the adverse factors are: Tangled landownership patterns; oversize plants and excessive mill capacity in relation to timber supplies; high property taxes in some localities, unsound financing and the resultant pressures for liquidation; and the difficulty, cost, and time required to put deteriorated woodland on a good management basis. Serious repercussions could be caused by war or depression.

Current prices are so high that liquidation-cutting may make the most money. The factors favorable to private forest management, however, give rise to the hope that forestry on large holdings will continue its recent advances. Even those companies that plan to operate on a liquidation basis should find it advantageous to apply such forestry measures as will assure natural regrowth because the market value of well-stocked young second-growth is so much greater than that of barren land.

There are, however, as has been pointed out, only about 3,600 forest holdings of 5,000 acres or larger. In 1945, lumber companies owned a total of 37 million acres; pulp and paper companies 15 million acres. Medium to large tracts also are owned by railroads, mining, and other industrial concerns. And a substantial amount of the forest area in holdings of 5,000 acres or larger is in nonindustrial ownerships, such as estates, banks, insurance companies, speculators, and timber producers who have no manufacturing facilities.

All together, these medium and large commercial forest holdings amount to about 84 million acres. But there are 261 million acres of commercial forest land in more than 4 million small holdings, farm and nonfarm. And it is on these lands in small ownerships that forestry has made the least progress. On these lands more than 70 percent of all cutting is still poor or destructive.

Private Forestry Yields Public Benefits

Good forest management on private forest lands yields important public benefits—greater assurance of an adequate, continuing supply of forest products; protection of watersheds; more game and fish; improved recreational values. Conversely, lack of adequate forest management can be seriously detrimental to the public welfare.

The public values in good forest management frequently outweigh the cost to the public of removing the obstacles to private forestry

and promoting its advancement. Public foresters and forest agencies have a special responsibility to bring such matters to the attention of both the general public and the individual forest landowners so that the proper actions may be taken to increase the public benefits through extension of private forest management.

Growing Stock Must Be Built Up

For an adequate sustained supply of forest products we must have an ample growing stock of timber. Plenty of trees of suitable kinds and of all age classes must be coming along to replace those harvested each year. It takes anywhere from 25 or 30 to 100 or more years—depending on species and site and use—for trees to reach commercial maturity. One can readily see that a very large stock of growing trees of various sizes is necessary for a continuing harvest.

To meet the prospective future needs of the United States, the Forest Service estimates that our annual growth of saw timber should be about doubled. And our present growing stock, viewed nationally, is not sufficient even to sustain the present annual cut.

Time is running short. Even if the best of forestry practice were applied everywhere immediately it would be many years before growing stock could be built up to the needed level. Meanwhile the Nation's use of saw-timber products in the years just ahead must come from an inadequate growing stock. Before adequate saw-timber growth rates can be achieved, a period of limited supply of saw-timber products seems inescapable. Shortages of some kinds of timber and of certain high-quality products already are being felt. The longer we delay in getting our forest resources on an upward trend, the greater will be the reduction in the use of timber products and the longer the time needed to reach our growth goals.

Meeting Our Responsibilities

If our responsibilities to our own generation and our obligations to future generations are to be met, destructive practices in the forests must be stopped. Our forest growing stock must be built up. The bulk of this job will have to be accomplished on private lands, since three-fourths of our commercial forest land is in private ownership.

In some countries this might be done by regimentation—by direct control of every operation, establishment of quotas, arbitrary restriction of consumption, and the like. That is the totalitarian system. And we Americans do not like it.

The Forest Service believes the better way to accomplish the job of building up our forest resources is through individual initiative and cooperative endeavor, under reasonable rules adopted through democratic processes. Some degree of regulation is necessary; regulatory measures are essential in our complex economy. "Rules of the game" are as necessary to resource management as they are to transportation, communication, and other enterprises that affect the public welfare.

A number of the States already have adopted regulatory measures of one kind or another applying to forest operations. Last year, the Supreme Court of the State of Washington upheld the State's forest practices law. The decision was later affirmed by the Supreme Court of the United States. In its opinion on this case, the State court said:

We do not think that a State is required under the Constitution of the United States to stand idly by while its natural resources are depleted. . . . When natural resources can be utilized and at the same time perpetuated for future generations, what has been called constitutional morality requires that we do so.

Washington's and Oregon's forest practices acts require the State forester's approval of the cutting system applied on a timber-harvesting operation. Mississippi's law specifies good cutting practice. Maryland's forest practice act provides for designation of minimum practices by local boards. Virginia requires a specified number of seed trees per acre to be left in commercial cuttings on pine lands. Several other States have laws concerned with cutting practice. In some of the States, however, little or no attempt has been made to carry out the laws. In most, if not all, the prescribed standards of forest practice are too low.

The Forest Service believes that reasonable regulations governing forest practices should be adopted in all States, and that certain basic Nation-wide standards should apply. The plan it has advocated would set up the basic standards through national legislation and would provide for Federal financial aid to States that adopted and carried out State forest-practice laws meeting those standards. It also would authorize the Federal Government to administer regulatory measures in any State which requested it, or which failed to put an adequate State regulatory measure into effect within a reasonable time. The basic standards would be such as to prohibit premature or wasteful cutting and other destructive practices, bring about progressive improvement of deteriorated and depleted forests, and provide for reasonable precautions against forest fires and loss from insects and diseases.

Such regulatory measures would aim at stopping further forest destruction and deterioration and so help to maintain at least a basic growing stock for future production. That is an essential first step. But regulation is not the whole answer. It will not of itself bring about sustained-yield management of the forests. Other measures will be needed to encourage and help forest owners go beyond the minimum requirements of regulatory laws toward maximum, sustained forest production.

We need to further strengthen the current programs of cooperative forest fire protection, reforestation, forestry extension, and on-the-ground aid to forest owners, as has been pointed out earlier in this report.

Some additional public aids also are needed. A publicly sponsored forest credit system to make long-term loans available to forest owners would facilitate the adoption of good forest management. Loans on terms and conditions adapted to the needs of private forest owners would help them to consolidate holdings for more efficient management and protection. It would help owners of young timber to meet the carrying costs of long-term timber-growing enterprises and to avoid sacrifice of their timber before it was economically mature. Such loans should of course be made contingent upon sound forest practices. A publicly sponsored insurance system would help to reduce the risks involved in such forestry enterprises, since fire losses could make it difficult for borrowers to meet loan commitments. Forest fire insurance at practicable rates is not now available to forest owners.

Cooperative associations of farm woodland owners and other forest owners should be encouraged. Farm co-ops for the marketing and processing of other farm products have been a boon to many farmers. Similarly, forest co-ops could enable farmers and other small forest owners to pool their resources for the purchase of equipment, employment of qualified forest managers or consultants, marketing of forest products, and in some cases for the operation of their own processing plants.

The Forest Service has made some studies of forest taxation and has suggested needed improvements. Many States have provided some special form of tax treatment for forest lands. Continued efforts to adjust tax systems applying to forest lands should be made, so that forest owners can meet their fair share of the tax load without the taxes being a deterrent to good forest management.

Cooperative protection against forest insects and diseases should be strengthened. Legislative authorization has already been provided in the Forest Pest Control Act for developing the needed action to discover and suppress outbreaks of destructive bugs and blights.

Continued and intensified work in all phases of forest research is of the utmost importance. Progress in forestry both on public and private lands depends on sound and expanding knowledge.

Along with the advancement of private forestry there should be full development of the forest resources in public ownership. The responsibilities of forest ownership apply to public lands as well as to private lands.

In its administration of the national forests, the Forest Service aims at permanent production and service in the best public interest. The best feasible cutting practice is required; sustained yield is sought in all timber management operations. But the full potentialities of the national forests are not yet being realized. Extensive stands of timber within the national forests are still in a nonoperating status because of lack of access roads. Much needed timber stand improvement, watershed improvement, and other resource development work is not being done because of lack of manpower.

Other Federal and State forest lands likewise have need for a great deal of development and improvement work.

Undoubtedly the national interest will dictate a larger amount of public ownership of forest lands—especially of important watershed lands, areas where acute problems of community stability exist, and lands where private enterprise is not likely to do the needed job of forest rehabilitation and management for permanent production. There is room and need for both public and private forestry in this country. Each can aid and supplement the other.

Whatever measures are taken, success depends ultimately on a public will to make and keep our forest resources strong. There is increasing evidence that the people of the United States so desire. With that public will translated into positive action, with full cooperation between forest owners and public agencies, all working together in the common cause, we can put our forest resources on the upward trend. And eventually we can achieve permanent timber abundance and other forest benefits in full measure.

THE NATIONAL FORESTS

The Granger-Thye Act (Public Law 478), approved April 24, 1950, was enacted by Congress to facilitate and simplify the work of the Forest Service. This act amended or repealed several acts under which the Forest Service has operated, and conferred certain additional authorizations. Most of its provisions have to do with administration of the national forests. Among other things, the act:

Authorizes noncompetitive purchase of forest tree seed or cones or forage plant seed when the amount does not exceed \$10,000;

Authorizes cooperation in performing on non-Federal lands within and near a national forest the kinds of work the Forest Service is authorized to do on Federal lands, provided the landowner pays the cost of the work;

Authorizes, under certain conditions, the expenditure of applicable Forest Service appropriations for the construction of buildings, lookout towers and other structures on non-Federal lands;

Authorizes term permits for use of Forest Service structures and improvements on national-forest lands, and provides that part or all of the fee may be in the form of maintenance and reconditioning of the structures;

Makes available national-forest protection and management appropriations for paying cost of installing telephone service in residences of seasonal employees and cooperators where necessary for the protection of the national forests;

Authorizes appropriation of certain amounts of national-forest grazing receipts for range improvements;

Provides statutory authority for grazing advisory boards;

Authorizes the issuance of term grazing permits for periods not exceeding 10 years; and

Amplifies previous provisions for emergency care of temporary employees in case of injury or illness.

National Forest Advisory Council

The National Forest Board of Review, established by the Secretary of Agriculture in 1948, was reconstituted in May 1950 as the National Forest Advisory Council. The purpose of the change in name was to differentiate the Board of Review more clearly from the National Forest Advisory Board of Appeals, established earlier in the year. There was also a desire to clarify the original intent that the Board of Review would be called upon to advise only on matters of broad general policy relating to national-forest administration. Advising the Secretary on ordinary appeals is now the function of the National Forest Advisory Board of Appeals.

The Secretary asked the three men who comprised the former National Forest Board of Review to continue to serve as members of the newly established Advisory Council. These men are Dr. Jonathan Forman, Columbus, Ohio; Prof. Gilmour B. MacDonald, formerly head of the Department of Forestry, Iowa State College, Ames; and Dr. Roland Roger Renne, president of Montana State College, Bozeman.

The National Forest Advisory Board of Appeals, established by the Secretary in January 1950, consists of five employees of the Department of Agriculture selected from agencies within the Depart-

ment other than the Forest Service. This Board is to advise the Secretary on any appeals to him from decisions of the Chief of the Forest Service involving public use of the national forests. Persons who wish to appeal decisions of the Chief of the Forest Service may appear before this Board if they so desire. The Board is directed to consider the appeal on its merits and furnish its advice and recommendations to the Secretary.

The following were appointed members of the Advisory Board of Appeals: John C. Bagwell, Chief of Production and Adjustment Division, Office of the Solicitor; George R. Phillips, staff member, Office of the Secretary of Agriculture; Edward G. Grest, Chief, Land Management Division, Soil Conservation Service; Dr. Stanley B. Fracker, Research Coordinator, Agricultural Research Administration; John A. Goe, Chief of the Wool Division, Livestock Branch, Production and Marketing Administration.

It has been the practice of the Secretary to call upon members of his staff to make an objective study of every appeal prior to his personal consideration and decision. A number of national-forest grazing permittees, however, had expressed a desire for a more formal arrangement. The Subcommittee of the House Committee on Public Lands, following a series of hearings dealing chiefly with Forest Service policy in the management of range lands, also had recommended the establishment of impartial advisory appeal boards. While most of the desire for a National Forest Advisory Board of Appeals thus sprang from grazing appellants, the Secretary felt that the Board should be given broad authority to consider appeals from any national-forest user.

Roosevelt National Forest Study

At the request of the Secretary of Agriculture, the National Forest Board of Review (now the National Forest Advisory Council) made a study of the grazing situation on the Roosevelt National Forest in Colorado. This study was requested because of the broad scope of the problem and the policy questions involved in reducing numbers of livestock permitted to graze in the Forest in order to protect watershed and other values from further deterioration.

The Board's report was completed in April 1950. It said that an evaluation of the various uses on the Roosevelt National Forest indicated that watershed values should be given first priority consideration. Recreation, including camping, picnicking, tourist travel, hunting, and fishing, was given second priority; livestock grazing, third; and timber uses, fourth.

Range lands or important watersheds visited on the Forest showed excessive deterioration, the Board said. It was stated that closure of limited areas to grazing seems to be justified where steep topography, eroding soil, and lack of vegetative cover make such action imperative in safeguarding the water and soil resources. The report added, however, that "there should be a clear and general understanding that it is not a major policy of the Forest Service to exclude grazing on any except such particularly unsuitable, limited areas."

The Board found on the Roosevelt National Forest an "accumulation or backlog of needed adjustments" in grazing use. It recommended "a careful consideration of these adjustments with a view toward spreading major reductions, to achieve moderate grazing, over

a period of more than 3 years, possibly 5 years." The technical procedures for range management on the Roosevelt National Forest appeared to be sound, the Board stated. Need for an intensified range research program was emphasized.

It was recommended that the Forest Service secure cooperation of sportsmen's organizations and State game officials in working out a program to control wildlife population, particularly big game, in order to obtain a proper balance of use between game animals and domestic livestock. The Forest Service was advised to work more actively, in cooperation with Extension Service and other agencies, in promoting better crop and forage production on private lands of grazing permittees. The Board's report said more funds for improvement of range facilities would increase the productiveness of the ranges in some districts and would be a factor in minimizing livestock allotment cuts. The principal needs were said to be fences and development of stock-watering places. In the administration of timber sales, the Board advised limitation of cutting to the extent necessary to protect watershed values. This might involve elimination of all timber cutting on critical areas, it was stated.

The Board of Review recommended formation of a Colorado Forest Resource Board, made up of representatives of all the major groups concerned with the use of the national forests in the State, to assist the Forest Service in formulating local policies and to help safeguard long-term conservation interests and promote the fullest use of all resources consistent with good management. The Forest Service already has taken steps to get such a board established.

Timber Management

Each year thousands of timber operators purchase national-forest stumpage. During fiscal year 1950, 26,907 timber sales were made, ranging from small transactions involving only a few logs to sales of millions of board feet. In all sales, the cutting must be done in accordance with prescribed forestry practices, under the supervision of Forest Service officers.

On March 29, 1950, 4,565,000 cords of pulpwood, standing on four national forests in Colorado, were sold at public auction. This, the largest sale ever made within the 48 States by the Forest Service, will supply the raw material for a pulp mill of 200 to 250 tons daily capacity for 30 years. One of the conditions of sale was that the successful bidder must erect a pulp mill on the western slope in Colorado. The auction resulted in preliminary award to the Columbine Development Co.—a Colorado corporation organized for the purpose of founding this desirable new industry in the western part of the State, where the present economy is largely agricultural.

This sale culminates years of effort by the Forest Service to help develop the latent industrial possibilities of the rugged Colorado mountain area. Heavy stands of Engelmann spruce predominate on the slopes and mesas of all but the highest mountains. These forests are of outstanding importance for watershed protection, and for timber production. Engelmann spruce wood is well suited to the production of newsprint and other papers, but the great forests of Colorado are distant from established pulp mills. It now seems economically feasible to build a mill near the timber and use the natural re-

source for making new jobs for workers and new products for the region.

The sale is in reality a gigantic salvage project. About two-thirds of the timber in the sale area is dead—killed by hordes of tiny bark beetles. These ghost forests of dead trees remain usable for pulpwood for many years in the high mountains where summers are short, relative humidity is low, and wood-destroying fungi are relatively inactive. Particular care will be used in logging to prevent damage to the watersheds and to the young trees which survived the beetle attack. The sale is of 30 years' duration, but the Forest Service envisions a permanent industry. After 30 years, additional mature timber will be available to furnish wood for the mill during the period while the young stands on the beetle-affected areas are maturing. The entire operation is geared to sustained yield.

Timber Cut Could Be Increased

The cut of national-forest timber amounted to 3,501,937,000 board feet during the fiscal year 1950. Receipts from timber sales totaled \$30,714,292, an average of \$8.77 per thousand board feet compared with \$7.69 per thousand board feet last year. Uncertainties in the lumber market during the summer and fall of 1949 slowed the rate of cutting, but demand increased during the winter and the cut during the last quarter of the year was 953,851,000 board feet, considerably larger than usual.

The national forests of the West have been described as "the rims and the remnants." The more accessible areas, carrying the heaviest stands of timber, had passed to private ownership before the national forests were created. In the Lake States, East, and South, the purchased national-forest lands largely were cut over and burned over prior to acquisition by the Forest Service. Many working circles, in both East and West, cannot be operated at sustained-yield capacity until developed by a system of primary haul roads or until the timber growing stock has been increased through protection and conservative cutting. On many million acres of commercial forest land in western national forests there are no present timber operations, primarily because access roads are lacking.

During the 5-year period, 1945-49, national-forest receipts exceeded 87 million dollars. Including special allotments of 12.9 million dollars of Veterans Emergency Housing Act of 1946 funds, the average amount expended annually during this period for construction of timber-haul roads was only about 5 million dollars. This was barely enough, along with the construction done by loggers, to maintain the cut of national-forest timber at just under 4 billion board feet a year.

Construction of roads to the remaining large inaccessible stands would permit increasing the national-forest cut by about 2 billion board feet a year, to a total of about 6 billion feet. The 2 billion increase at present prices would bring into the Treasury over 15 million dollars a year indefinitely.

Currently less than one-third of the 650 national-forest working circles are operating at the sustained-yield level. In the West the chief reason is the lack of access roads. On eastern national forests many of the working circles where the cut now equals sustained yield at the present level of stocking can support increased cuts in the future because up to 50 percent of the current annual growth is allocated

to increasing the growing stock. Thinnings and improvement cuts insure better growth of higher quality material.

Progress in obtaining satisfactory timber inventories has been slow. As demand for national-forest timber increases and more intensive practices become practicable it is necessary to get and to maintain adequate inventories of the volume and location of timber on each working circle. Such data are necessary to the preparation of management plans. During the year, 8 timber management plans were approved, covering 756,000 acres of commercial forest land. It is estimated that timber inventories are needed on 71 million acres and that 659 management plans should be written or revised during the next 10 years. The unit cost of inventory and management plan work averages less than 10 cents per acre. A great deal of this work is needed now to bring the program up to date.

Sustained-Yield Units

Two Federal sustained-yield units were established during the year under authority of the Sustained Yield Units Act of 1944. An advisory public hearing was held at Aberdeen, Wash., in August 1949 at which interested local representatives of timber manufacturing industries, civic organizations, organized labor, and local government heartily endorsed the proposed Grays Harbor Federal sustained yield unit on the Olympic National Forest. The unit was established November 2, 1949. The committed national-forest lands are managed under sustained yield and the allowable annual cut of 60 million board feet will help greatly toward maintaining a stable base for the extensive primary and remanufacturing industries in the Grays Harbor area. All timber sales are competitive, but local manufacture is required. Maximum remanufacture in the area is one of the primary considerations. The huge timber-processing industry at Grays Harbor, developed for exploitation of extensive stands of private timber, no longer can be fully supported unless there is continuing development of new industries which utilize waste material and remanufacture the products of the sawmills and veneer plants, thus adding materially to the industrial payroll which is the backbone of the community's stability.

Also established during the year was the Big Valley Federal sustained yield unit on the Modoc National Forest. The advisory public hearing was held at Alturas, Calif., October 19, 1949; the determination and declaration establishing the unit was executed January 27, 1950. This competitive Federal unit was established to support the economy of the small rural communities in the Big Valley area of northeastern California. It includes 82,000 acres of national-forest land which supports a total stand of about $\frac{3}{4}$ billion board feet of timber. The allowable annual cut is 8 million board feet, which must be manufactured within the Big Valley locality.

On March 7, 1950, an advisory public hearing was held at Lakeview, Oreg., on a proposed Lakeview Federal sustained yield unit.

Forest Pest Control

Work continued on the control of white pine blister rust through the eradication of *Ribes* (currant and gooseberry) plants, on which the disease spores are produced. Experimental use of helicopters for

spreading plant killers, such as 2,4,5-T, show considerable promise in developing improved and cheaper techniques.

Insect infestations which caused major losses of national-forest timber during the year included (1) spruce budworm, defoliating Douglas-fir in Oregon and Washington, (2) bark beetle infestation in lodgepole pine in northwestern Wyoming and eastern Idaho, (3) bark beetles infesting western white pine and lodgepole pine in northern Idaho and western Montana, (4) bark beetles in ponderosa pine in South Dakota and Colorado, and (5) bark beetle epidemic in Engelmann spruce stands in Colorado.

The spraying of 250,000 acres in western Oregon, reported last year, was highly successful in controlling spruce budworm. Practically all the insects were killed on the sprayed areas. Surveys during the summer of 1949 disclosed, however, an additional 887,000 acres of heavy infestation and 1,380,000 acres of light infestation. These are largely in eastern Oregon and Washington. The stumpage value of the threatened timber exceeds \$50,000,000. Using available Federal, State, and private funds, totaling close to \$1,000,000, another huge aerial DDT spraying job was conducted in cooperation with the States in the spring of 1950. Some 940,000 acres were sprayed at a cost of \$1.06 per acre.

Control operations continued in the areas of mountain pine beetle infestation in Idaho, Montana, Wyoming, South Dakota, and Colorado. Bark beetles must be attacked from the ground by spraying each individual tree. The larvae which must be killed are under the bark of the trees and aerial attack is ineffective.

The Engelmann spruce bark beetle has killed more than 4 billion board feet of timber in Colorado in the past 9 years. All the Engelmann spruce stands in Colorado, worth at least \$40,000,000 on the stump, are threatened. With new, effective control methods recently developed, control operations were started in June 1950 with emergency funds made available by Congress. This job was to continue through the summer and until fall snows closed the camps. Plans called for treating some 500,000 trees in the 1950 season. The purpose of the treatment is to prevent the spread of the infestation to other areas of green timber and prevent additional timber killing on a large scale.

Reforestation

The Anderson-Mansfield Act, approved October 11, 1949, authorizes increased appropriations for reforestation and revegetation of the national forests. It authorizes a scale of appropriations which would permit planting 4 million acres in 15 years. The appropriation for reforestation in fiscal year 1951, however, was much less than the authorization for that year.

During the year, 45,428 acres of national forest were reforested artificially. Of the total, 44,090 acres were planted with nursery stock, and 1,338 acres direct-seeded. This work was conducted in 83 national forests, but 85 percent of it was done in the Lake States, the South, and the Pacific Northwest.

Tree-planting machines are used where topography and ground cover permit, but in rugged mountain areas most of the planting must be done by hand. In the nurseries, however, a high degree of mechanization is used. During the year 13 national-forest nurseries provided 45 million tree seedlings and transplants ready for planting.

Held in stand-by condition or under special use permit to State agencies were 9 nurseries.

Range Management

During 1949, 21,088 paid permits were issued to stockmen, authorizing them to graze 1,125,639 cattle and 3,092,229 sheep on national-forest ranges. In addition 66,492 cattle and 5,280 sheep kept for domestic purposes by 5,738 owners (exclusive of those owners who also held pay permits) were permitted to graze free of charge.

The grazing fees are adjusted each year in accordance with the market prices of livestock for the preceding year. Because of high market prices received by producers in 1948 for beef cattle and lambs, grazing fees reached an all-time high in 1949, averaging 49 cents for cattle and 11 cents for sheep per head per month. They were somewhat lower in 1950, averaging 42 cents for cattle and 10.75 cents for sheep per head per month. Total grazing receipts for fiscal year 1950 amounted to \$3,385,004.

A great deal of attention has been given by the Forest Service during the past year to grazing situations of an especially acute nature in order to make sure that adjustment programs proposed by the regional offices are entirely justified. Heavy reductions in numbers of permitted livestock usually have an adverse effect on the local livestock operations. Such adjustments are undertaken, therefore, only when it seems perfectly evident they are essential to the protection of other high values in the national forests, especially the watershed values.

The Forest Service is not relying alone upon reductions in numbers of livestock as a means of protecting and improving the range. Just as rapidly as appropriations are made available by the Congress the funds are used to rehabilitate the ranges through reseeding operations and the construction and maintenance of range improvements. Sixty-seven thousand acres of national-forest range were reseeded during the fiscal year 1949, bringing the total acreage reseeded up to June 30, 1949, to more than 270,000 acres, at a total cost of \$1,882,759. Exclusive of range reseeding, the investment in range improvements up to June 30, 1949, amounted to approximately \$16,000,000. Improvement work done to date includes 28,000 miles of range fence and corrals, 3,500 miles of livestock driveways, and 15,760 water developments. The ranges have also had the benefit of programs designed to control the spread of range-destroying rodents and to eradicate poisonous and noxious weeds and plants.

Contemplated further work, as funds become available, includes the reseeding of about 4,000,000 acres of range land, construction of 1,500 corrals and 30,000 miles of range fence, 23,000 range water developments, 9,500 miles of stock driveways, control of poisonous and noxious plants on 439,000 acres, and of rodents on 15,000,000 acres.

The 15-year program for reforestation and revegetation of national-forest lands authorized by the Anderson-Mansfield Act last year included authorizations for range reseeding on a graduated scale for the first 5 years, increasing from \$1,500,000 in fiscal year 1951 to a maximum of \$3,000,000 in 1955, with a like amount for each subsequent year through the fiscal year ending June 30, 1965, and thereafter such amounts as may be needed for range revegetation. The specific authorizations terminate in 1965, by which time, assuming the

authorized funds are appropriated, it is contemplated that the bulk of the work will have been completed. Thereafter such amounts (presumably smaller) as will be necessary are authorized. Under the planned program of range and watershed rehabilitation a large amount of depleted range and watershed land in the national forests can be restored to productivity through reseeding and made to support from 5 to 10 times the number of livestock now carried. Congress, however, did not appropriate the full amount authorized for the first year of the contemplated 15-year program.

National Forest Advisory Council

In addition to the Roosevelt National Forest study previously mentioned (p. 36), several important grazing questions were submitted by the Secretary of Agriculture to the National Forest Advisory Council for consideration and recommendation.

The Council was asked to consider the plan of the Regional Forester in Albuquerque for adjusting sheep grazing in portions of the Carson National Forest in New Mexico, with special reference to the principle back of the sliding-scale method of making necessary adjustments in grazing use, whereby the burden of adjustments is lighter on the small permittees than on those with large permits.

The Advisory Council (at that time known as the Board of Review) held a hearing in Denver on January 20, 1950, for the purpose of reviewing two features of national-forest grazing policy—transfer adjustments and grazing trespass. This review had been requested by a joint committee of the American National Live Stock Association and the National Wool Growers Association by resolution adopted last year. The Council submitted its report on the matter of transfer adjustments in July. It recommended retention of the policy covering transfer adjustments, but suggested certain clarification of procedure.

Granger-Thye Act Provisions

Section 12 of the Granger-Thye Act of 1950 authorizes the appropriation of an amount equivalent to 2 cents per animal-month for sheep and goats, and 10 cents per animal-month for other kinds of livestock under permit on any national forest, to be available until expended on such national forest for various range improvements specified in the act. On the basis of livestock-months permitted in 1949, the full appropriation under this authorization would amount to about \$762,000 for fiscal year 1951.

Section 18 of the act provides for the election of local grazing advisory boards. This section simply gives statutory recognition to a procedure which has been followed by the Forest Service for many years.

Section 19 authorizes the issuance of term grazing permits for periods not exceeding 10 years and for renewal thereof. This section likewise gives specific statutory authority for an established practice.

Watershed Management and Flood Control

National forests contribute much to the total water supply of our country, since they are for the most part located in the mountain areas which generally receive the greatest amount of precipitation. In watershed management, the Forest Service continues to focus atten-

on problems of erosion, sedimentation, and runoff to bring about improvement in the watershed lands of poorer quality. More consideration is also being given to the potential usefulness of national-forest water resources in the upland watersheds themselves.

In California, the Forest Service is cooperating with the State Water Resources Board in a study of water resources of the State. Estimates are being made of the present and future needs for water for all consumptive uses within the boundaries of the California national forests.

On the Boise National Forest a watershed restoration program is being undertaken through a cooperative arrangement between the Bureau of Reclamation and the Forest Service. The program involves reseeding badly depleted watershed lands tributary to the Arrowrock Reservoir, which supplies irrigation water in the vicinity of Boise, Idaho. Small upstream channel stabilizing structures and other measures are proposed for later installation to complete the rehabilitation in the tributary drainage area.

In Utah, the Wellsville Mountain Area Project Corporation and the Weber County Watershed Protection Corporation are now working with the Forest Service to encourage private landowners within and near the Cache National Forest in developing land-use management plans for protecting all critical watershed lands.

The Forest Service participated in the preparation of reports on certain major drainage basins and other information, in response to requests from the President's Water Resources Policy Commission. Individual reports prepared by the Forest Service on the forests and forest ranges of the basins provided information on forest-land conditions, the relation of forest lands to water resources, and related matters. In many drainage basins the national-forest lands are of critical importance in protecting and improving the usefulness of water resources.

No new watershed projects in aid of flood control were authorized by Congress in the past year. Programs on watersheds for which work has already been authorized are continuing, with increasing cooperation from local public agencies. Programs in which the Forest Service is participating are under way on the Los Angeles, Santa Ynez, Yazoo, Little Tallahatchie, Coosa, and Potomac River watersheds.

Recreation

The public in increasing numbers continues to seek outdoor recreation on the national forests. In 1949 there were approximately 2,000,000 visits to national-forest areas, an increase of 9 percent over 1948. Public campgrounds, picnic areas and winter sports areas had 1,200,000 visits. The remaining 12,800,000 visits were to organized camps, resorts, summer homes, wilderness areas, hunting country, and fishing lakes and streams.

There has been much discussion and Congressional interest as to whether recreational use in the national forests should bring in some revenue to offset, at least in part, the cost of recreational administration and maintenance of recreational facilities. A moderate charge for the use of some of the larger improved camp and picnic areas was tested experimentally during the 1949 season. Results of the 1949 experiment did not show conclusively whether it was feasible or

desirable from a public standpoint to make such a charge a permanent Forest Service policy. The experimental charge therefore was continued in 1950. It is hoped that the results of this second year's trial will provide a sufficient basis for the formulation of future policy.

Most of the camp and picnic-ground facilities, such as fireplaces, tables, garbage pits, water and sanitary systems, were constructed during the work relief programs of the '30s and many have deteriorated to a point where upkeep is very costly. Many of these old facilities cannot be maintained much longer and need to be replaced. In most national forests additional improvements are needed to take care of the increased number of recreationists and to prevent serious overuse which is now wearing out many of the existing areas.

The increasing recreation use makes it essential that the accompanying fire and sanitation problems be provided for. Because of inadequate facilities many people camp and picnic on unimproved areas where there is danger of polluting water that is used for domestic purposes. The risks of costly fires are increased when the camper builds his fire in locations that have not been provided with fireplaces.

Avalanche Control

Winter sports use has made it necessary for the Forest Service to give attention to avalanche prediction and control. The best ski areas are potential avalanche areas and the safety of skiers depends on the knowledge and skill of Forest Service personnel who administer these areas.

Last winter, a training school in snow avalanche forecasting and control was held at Alta, Utah, attended by forest officers from Western States. This was the first school of its kind held in the United States. The instruction was based on knowledge gained during the past 10 years by Forest Service snow rangers at Alta.

Trials conducted in cooperation with the National Guard have definitely shown it feasible to use artillery projectiles to precipitate snow avalanches at a safe time. Nine of these snow slides were brought down in a period of a few minutes by firing 75-mm. shells at the release points. It would have involved several days and considerable hazard to have released these same slides by hand-set explosives. It is anticipated that this method of avalanche control will become common practice as a means of making ski areas, mountain highways, and railroads safer during winter months.

Airspace Reservation

The establishment of an airspace reservation over the Superior Roadless Areas by Executive order of the President was a milestone in wilderness area protection. The President's order prohibited landing in or flying at less than 4,000-foot altitude over the designated roadless area in Minnesota so that the wilderness values of this unique country would not be destroyed. This was the first airspace reservation ever made in America for other than national-defense or safety purposes.

Mining and Special Land Uses

In 1950, 49,806 special-use permits involving 3.7 million acres of national-forest land were in force. These permits authorize the use of national-forest land for a variety of purposes, including summer

omes, resorts, ski lifts, range fences, water developments, telephone lines, railroads, pastures, etc. Permits for uses that serve public purposes and are of a noncommercial nature were issued free. There were 21,040 of these. Charge permits yielded \$750,862. Of this amount approximately \$405,000 was derived from permits that relate to recreational use.

Requests for summer home permits are coming faster than forest officers can plan and survey tracts for this purpose in most national forests. In 1949, 16,239 summer home permits were in force—an increase of 1,109 over the number in 1948.

In addition to the special-use permits issued by the Forest Service there are 543 Federal Power Commission permits and licenses for dams, power plants, and transmission lines involving national-forest land. Rights-of-way easements across national-forest land granted by the Department of the Interior number 529 and cover 47,000 acres.

Interest in gas and oil leases on national-forest lands continues to increase, especially on western and southern national forests. Last year the Forest Service made over 4,000 reports on applications to the Bureau of Land Management, Department of the Interior, which issues the leases. The California region alone reported on 1,285 applications covering 750,000 acres. Receipts from oil and gas leases on national-forest land withdrawn from the public domain are not credited as national-forest receipts, but are deposited and distributed as other receipts from public-domain lands. Receipts from oil and gas leases on national-forest lands acquired under the Weeks Act are credited to the Forest Reserve Fund, 25 percent of which is paid to the States each year for country road and school funds.

Mining Claims

Approximately 76,000 recorded mining claims cover 1,800,000 acres in western national forests. The area covered in these claims supports an estimated 7,000,000,000 feet of timber worth \$58,000,000. A claimant can secure patent to bona fide claims under the United States mining laws and obtain title to the timber as well as the minerals. On many mining claims the timber values far exceed the estimated value of the minerals, and some claimants use the mining laws as a guise to obtain title to the timber.

Since the present mining laws do not take into account public values other than minerals, it is possible for the development of minor mineral values to seriously jeopardize other important public-land management. It is becoming increasingly imperative that some solution be found that will prevent abuses of the mining laws and enable public-land administrators to weigh the value of mining developments against the effect on other public values.

Wildlife

Emphasis in the field of wildlife management on the national forests is being placed on the coordination of wildlife management with other resource-management work, and on the strengthening of cooperative relations with the States.

The coordination job accomplishes wildlife-management objectives through modification of existing methods or application of special practices in the management of the other resources, such as timber

and range. This results in much accomplishment at reasonable cost and also conforms closely with the multiple-use policy in managing national-forest lands.

The States make and enforce the laws necessary to protect and utilize the wildlife on the national forests. The Forest Service give primary attention to the maintenance of a suitable habitat for wild life. If good hunting and fishing consistent with other resource requirements is to be provided, close cooperation between the Forest Service and the State game and fish departments is of paramount importance.

The Appropriation Act for 1950 did not provide any funds specifically for national-forest wildlife management and only a skeleton organization was maintained by the transfer of funds from other activities. Not only did this greatly restrict wildlife-management work but other activities suffered likewise.

Use of the national forests for hunting and fishing continues at a high level. An estimated 1,720,000 hunters and 2,960,000 fishermen visited the national forests in fiscal year 1950. No estimates are made of the take of fish, but hunters took an estimated 318,000 head of big game. The popularity of the national forests with hunters and fishermen is due not only to the excellence of the sport obtained but also to the fact that the 180 million acres of national forest is one of the largest good hunting and fishing areas that remain open to the public.

For many years the Forest Service had made an annual estimate of big-game populations on the national forests, based on reports from the field offices as of January 1. This year the method of submitting reports from the field was changed to a fiscal-year basis. This change will permit the estimates of big game to be made after winter losses have taken place and before the spring crop of young animals has arrived. Under the new system a better analysis of populations and hunter kill following the fall hunting season will be possible because ample time will be available to correlate Forest Service estimates with those made by the State game departments.

Cooperative Programs

The successful Forest Service-State cooperative programs in the East and Southeast continue to be popular with sportsmen and are providing good hunting and fishing on areas where, a few years ago, game and fish were either absent or very scarce. These programs provide intensive management on special wildlife-management areas. Usually they involve the collection of special fees by the States, and these are shared with the Forest Service. The money is spent primarily on habitat improvement and maintenance, which is the key to maximum wildlife production.

This type of cooperative management has now spread to the West. Arizona has two wildlife-management areas in operation. One of these, the Three Bar Quail Management Area on the Tonto National Forest, was established during the past year. Management on this area will provide for numerous small water developments for quail, fencing for protection of the habitat from livestock use, and construction of roads to permit hunters to reach previously inaccessible areas. Managed hunting will be emphasized, and various methods of hunt management will be demonstrated.

A new cooperative agreement was signed with the State of Penn-

sylvania for the establishment of an intensive wildlife-management program on the Allegheny National Forest. Activities of the Forest Service and the State will be coordinated in a program designed to improve wildlife habitat. Initial projects financed by the Pennsylvania Game Commission have already been started.

New cooperative agreements which outline the broad working relationships between the Forest Service and the States were signed in Illinois, Michigan, and Mississippi. These will aid greatly in coordinating Forest Service and State activities in wildlife management on the national forests in these States.

The severe winter in the Western States did not result in large losses of big game, as many people had feared. Losses were severe only in localities having recognized overpopulation. The heavy snows, by concentrating big game in small areas, made "census" taking relatively easy and very good estimates were obtained on a number of herds.

Management of that magnificent game bird, the wild turkey, was considerably advanced. Colorado had the first open turkey season in many years. This resulted from the restocking of many national forest areas by the Colorado Fish and Game Department. Wild turkeys were reported to be increasing on the national forests of Virginia and West Virginia, and their range is spreading northward through the Allegheny National Forest in Pennsylvania.

Grouse received special attention in habitat management in Virginia and Idaho. Forest-management practices to improve game food and cover conditions may result. This attention to small-game species is especially important. With the increased demand for hunting on the national forests, it is becoming more and more difficult to maintain a high degree of hunter success. The productive capacity of the national forests for wildlife has a definite limit. Many big-game ranges are already fully stocked, or even overstocked. Where small game can be produced in greater quantities, the possibility of satisfying more hunters is much greater.

Fishing is a popular sport on the national forests. Fire protection, range management, watershed management, and proper timber-cutting practices all contribute to the maintenance of a desirable fish habitat. The Forest Service-State cooperative programs in the Southeast are outstanding examples of good fish management that furnishes high quality sport to the fisherman. Although the number of fishermen is increasing each year the average catch of nearly six fish per day is being maintained. This is the result of special management measures carried out jointly by the Forest Service and the States.

Fire Control

During the calendar year 1949, 11,501 fires were controlled by the Forest Service and its cooperators. These fires burned 155,914 acres of national-forest lands and 34,950 acres of private lands inside national-forest boundaries. The cost of fighting these fires approximated \$7,000,000.

Measured against the total national-forest and intermingled private land under protection, the area burned was less than one-tenth of 1 percent. This would seem to indicate that Forest Service protection forces attained considerable success in the control of forest fires. On

certain localized areas, however, the losses were heavy. For some national-forest management units the protection forces were unable to maintain the degree of protection necessary to successful resource management. Many of these units included highly productive timberlands or highly important watershed lands.

Fire protection can be considered adequate only when a satisfactory degree of protection can be maintained year after year on every management unit. The chances for success in maintaining such protection over large areas in the western national forests and in some sections of the East are actually becoming less, in spite of increasing knowledge and experience and improved fire fighting techniques. This is true for many reasons.

For one thing, the hazard is increasing. During the early thirties much mature timber in the West was attacked by insects, resulting in almost total destruction of many timber stands. Timber was killed over large areas in Montana, Idaho, Colorado, and Wyoming, and in localized areas in other States. In Colorado, standing dead spruce covers about a million acres. In other areas, most of the bug-killed timber is now on the ground. The tangled masses of fallen trees make a very serious fire-control problem. In some places only about 2 feet of fire line can be cleared per man-hour.

Disposal of logging slash lagged far behind the greatly increased timber cutting in many western national forests during the war period and after. Heavy accumulations of slash have magnified fire control problems.

A change in grass types has occurred over large areas of range land in the West. Ranges that once supported good stands of perennial grasses now have annual grasses that dry out early in the summer. Fires start more easily and spread faster in such areas. The season of hazard is longer. On many areas once considered relatively "easy fire chances," control of fires is now proving extremely difficult. Sooner or later large run-away fires are bound to occur unless increased offsetting measures are taken to control fires that start in these areas.

Use of the national forests is expanding. More industrial and recreational use, and greater numbers of residents and workers in and near the national forests are exposing more area to more risk. Nation-wide and local fire prevention programs are helping to make more people careful, but so long as some remain careless or indifferent, the potential for man-caused fires is always present.

Meeting the Increased Threat

Within the limits of available funds, the Forest Service is taking aggressive action to meet the threat of increased hazard and risk. In the southeastern national forests more than 100 tractor-drawn plow units are now being used. Where these are available, the area burned by the average fire has been reduced 50 percent, compared with fires fought by hand methods. During 1949, more than 40 percent of all fires starting in national forests of the Southeastern States were controlled with these units.

"Smokejumpers"—parachute-jumping fire fighters—are becoming more and more valuable in the control of fires in inaccessible areas of the western national forests. The Forest Service smokejumper

corps in 1949 numbered 252 specially trained men. They made more than 1,300 individual jumps to 354 fires.

Airplanes are used extensively for reconnaissance, transportation of fire fighters, dropping food and equipment to fire fighters on inaccessible areas, and for many other uses. During 1949, 6,060 flights were made, and approximately 8,700 men and 1,300,000 pounds of cargo were transported.

Forest Service use of helicopters on large fires increased in 1949 and 1950, especially in California. Helicopters under contract made 897 flights. The principal uses were for scouting and mapping large fires, transportation of fire fighters from place to place on the fire line for quick action on "hot spots", removing injured personnel, and applying remote fire camps. In 1949 two fires were initially attacked by men delivered in helicopters.

Tank trucks are being used increasingly for initial attack on fires, especially in the far West. During 1949, tankers were used on more than 2,300 fires, and were the principal means of control on 1,000 of them. Tractor dozers are also used in the control of many large fires. Last year, more than 400 miles of fire line was constructed with tractor dozers in western national forests. In one region they accounted for some 50 percent of all fire line constructed.

But even with all the continual improvements in equipment and methods, the situation today is more critical than it was prior to 1945. Hazards and risk are greater. Higher wage rates for fire-fighting personnel, higher costs of materials and equipment, the 40-hour week, and other factors have increased operational costs. As a result, the over-all strength of the national forest fire control organization is lower, compared with what less money paid for 5 years ago. If the national forest fire protection organization is to be able to guarantee adequate protection for every management unit, increased manpower and facilities are essential.

The 1950 Fire Season

A tough fire season started early in 1950 in California, Arizona, and New Mexico. National forests in these States had many bad fires. In California, the burned area up to August 31 was greater than that burned in any year of the past decade. One disastrous fire showered the city of San Diego with ashes while burning 60,000 acres of watershed lands vital to the city's water system. The same fire burned 24 buildings and caused evacuation of one town.

The Southwestern region experienced only 1 year during the '40s that equaled 1950 in acreage burned. In the Southeastern States, burning conditions were unusually severe during the spring of 1950. Such conditions resulted in some 600 more fires in national forests of the region than in 1949.

Up to July 31, the Forest Service had fought 5,502 fires in the national forests. The area burned was 145,485 acres, compared with an average of 103,864 acres for the corresponding 7-month period of the preceding 5 years.

Improvements and Facilities

The Federal Aid Highway Act of 1948 authorized an annual appropriation of \$17,500,000 for forest development roads and trails.

The amount actually appropriated for the fiscal year 1950 was \$10,348,000. There was an additional \$3,087,830 of "10 percent funds" (representing 10 percent of national-forest receipts authorized for expenditure on national-forest roads). About \$2,000,000 of an appropriation for flood-damage repair was also available, mostly for work in national forests of the Columbia River Basin.

About \$5,000,000 of these funds was used for new road construction and improvement. The rest was required for regular and emergency maintenance. Only a minimum of maintenance to serve light traffic is financed with Federal funds. Logging operators accomplish and finance the road maintenance required for their heavy hauling. The Forest Service may cooperate in maintenance of national-forest roads that carry a considerable amount of general public traffic, and are therefore included in the county road systems or are similar to county roads in the services they render, but the share of work required to serve the general public use, school busses, mail routes, and the like is usually the responsibility of the local authority.

The road and trail transportation system in the national forests consists of a total of 107,731 miles of roads and 127,283 miles of trails. About 54 percent of the roads and 27 percent of the trails are not of satisfactory standard. Reasonably adequate protection and full use of the national-forest resources require the improvement of those roads now inadequate or in poor condition, together with the construction of about 36,000 miles of new roads.

Urgently needed now is the improvement and dust-proofing of small mileage that carries heavy concentrations of traffic to campgrounds and recreation areas.

A much larger immediate need is the extension and improvement of roads for log hauling, necessary to the proper management and harvest of national-forest timber. As pointed out earlier in this report much timber is now being lost because it cannot be reached as the trees mature or die from insect infestation and disease. An investment of \$100,000,000 within the next few years for main log-hauling roads would make possible the harvest at the sustained yield rate of about 6 billion board feet a year. With a continued program of lateral road construction thereafter, much of which is done by the timber operators, the timber could be harvested at this rate indefinitely. At current prices this would bring into the Federal Treasury about \$45,000,000 annually.

Water Developments

Use of water from the national forests increases at an accelerating rate. Hydroelectric power in particular is being developed in many forests to meet mounting needs. Where domestic water-supply requirements, irrigation needs, fishing, recreation, or other uses are competing for the same stream flow, conflicts may develop. The Forest Service, as administrator of the lands that are the source of the water, must plan for the greatest benefit to the greatest number. Studies to establish priorities are necessarily a part of this work. Overappropriation of some stream flow in the West is requiring attention to water rights.

The long-term Federal Power Commission power license granted the Southern California Edison Co. for its Kern River Plant No. 1 contains a provision for the release of enough water below the diver-

sion dam to maintain recreation values important to the population tributary to this river near Bakersfield, Calif.

Dam repair has become a major problem on more than a dozen Forest Service structures, partly because maintenance was deferred during the war. In the past year the Forest Service was called upon to review plans for 10 dams for which special-use permits have been issued. This is exclusive of the numerous large power, irrigation, and flood-control dams proposed by other Federal agencies or private capital in connection with river-basin development or Federal Power Commission power licenses.

Aerial Photography and Mapping

Forest Service mapping is limited to national-forest areas that are unlikely to be mapped by the United States Geological Survey in time to meet urgent forest-management requirements. Last year, surveys for planimetric mapping covered 11,668 square miles of national-forest lands in various Western States. One standard topographic quadrangle was published for administrative use. Three quadrangles—two in California and one in Washington—were completed through manuscript stage. Forest Service surveyors completed 70 percent of the field control needed for constructing topographic maps covering approximately 3,740 square miles on national-forest land in Arizona, Idaho, and California. Standard maps made by the Forest Service are turned over to the United States Geological Survey for publication.

Mapping funds available to the Forest Service continue to fall short of financing the standard maps needed for management of the forests. In the meantime, planning sheets prepared in developing standard maps have to suffice as forest administrative maps.

Contracts were placed for aerial photography totaling 17,404 square miles, including 1,850 square miles secured by cooperation with the United States Coast and Geodetic Survey.

In addition to the standard quadrangle, 37 administrative maps and 5 recreational folders were lithographed during the year. Printing funds available allow only a limited public distribution of Forest Service planimetric maps.

National-Forest Properties

The Forest Service currently administers 151 national forests, 41 purchase units established with the approval of the National Forest Reservation Commission pursuant to the Weeks Law, 17 experimental units, and 11 land utilization projects. These include a total gross area of 229,341,063 acres and a total net area administered by the Forest Service of 180,758,433 acres. This net area represents an increase during the fiscal year 1950 of 384,645 acres.

The Forest Service also administers approximately 92,000 acres of lands acquired by the United States for rural rehabilitation purposes. It is also the custodian of the Federal interests in 466,563 acres of land and utilization project lands which are managed for forestry and related purposes by several States under lease and cooperative agreements.

Boundary Changes and Readjustments

In the interest of more economical and effective management, the LaSal National Forest in Utah and Colorado has been consolidated with the Manti National Forest. The consolidated National Forest will be known as the Manti-LaSal.

Public Land Order No. 607, dated September 20, 1949, extended the boundaries of the Wasatch and Uinta National Forests in Utah to include an additional gross area of 23,238 acres. Of the land so included, 3,034 acres are public domain and the balance are privately owned. These lands are highly important from a watershed standpoint, and including them within the national-forest boundaries will permit gradual acquisition of those which are overgrazed, eroded or otherwise in an unsatisfactory condition, with a view to restoring their watershed capacities.

Land Purchases

For fiscal year 1950 Congress appropriated \$401,000 for purchase of lands under the Weeks Law of 1911, \$136,540 for land purchase pursuant to the various "receipts acts," and \$75,000 for acquisition of privately owned lands within the Superior National Forest Wilderness Area, as authorized by Public Law 733 of the Eightieth Congress. During the year the National Forest Reservation Commission approved the purchase of 276 tracts involving 51,569 acres under the Weeks Law, 18 tracts comprising 6,633 acres as authorized by the receipts acts, and 37 tracts involving 2,876 acres within the Superior National Forest. The lands purchased pursuant to the Weeks Law were all situated within previously approved purchase units and were selected to contribute the most toward consolidation of these units and to promotion of timber production and conservation of watersheds. Public ownership of the tracts purchased within the Superior National Forest Wilderness Area will forestall developments destructive of the primitive environment which the Forest Service is striving to preserve. Lands were purchased in 40 national forests or purchase units situated in 26 States and Puerto Rico.

Forest Exchanges

A total of 179 applications for the exchange of privately owned county, or State lands within or near the National Forests for national forest lands or timber, or land utilization project lands, were reviewed and approved during the fiscal year. One hundred seventy-four exchange cases were consummated and title was accepted to 271,756 acres of land within the national forests. For such land the Government gave or will give 36,036 acres of national-forest or land utilization project lands and cutting rights to 352,932,000 board feet, more or less of national-forest timber.

Many of the approved exchanges involved the trading of small tracts of land with farmers or other local residents for the mutually beneficial purpose of consolidating or building up both farm properties and national forests. A number of land-for-land transactions involving timber and range lands were also approved for the purpose of consolidating ownerships, making management of both Federal and private properties more economical, and acquiring private lands more urgently needed and better suited for public purposes than the national-forest lands granted in exchange. Congress passed three special

exchange acts authorizing (a) an exchange of national forest and flood control lands in Arkansas; (b) an exchange of a national forest airport site for lands needed for national forest administrative purposes in California; and (c) an exchange of a small tract acquired for forest nursery purposes in Ohio for lands in the Ohio national forests purchase units.

Miscellaneous Acquisitions and Disposals

The Forest Service accepted 13 separate donations of lands for national-forest purposes, the total area so acquired being 1,631 acres. Of these donations, 4 tracts including about 10 acres were primarily for administrative sites. The remaining lands are suitable for timber production and other national-forest purposes. Nine tracts were purchased pursuant to the act of March 3, 1925, for sites for ranger stations or other administrative facilities, or as additions to existing sites.

Two tracts comprising 76 acres were conveyed pursuant to Section 16 of the Federal Airport Act; and 16 acres, a part of the Desert Range Experimental Area, were sold to the Sisters of St. Joseph of Tucson, Ariz., for a hospital site pursuant to a special act of Congress.

As the foregoing summary indicates, some progress was made in the job of blocking in and building up the national forests which is so necessary to effective administration and proper functioning of these areas for forest and water conservation purposes. The existing national forests and purchase units, however, include about 35 million acres of lands still unacquired, although primarily suitable for national-forest purposes. Some 23 million acres of the unacquired lands are situated within the national forests and purchase units east of the Great Plains. These national-forest areas were in large measure established under the purchase program authorized by the Weeks Law, as amended, to facilitate and promote watershed protection and timber production. Consolidation and development of these national forests within a reasonable period of time will require a greatly accelerated purchase program. Such a program, however, would certainly be a justifiable and productive investment for the Nation, for it would be a basic step toward better protected watersheds, increased supplies of timber, expanded public recreational opportunities, and enlarged public hunting and fishing grounds.

RESEARCH

Forest Management

The natural regeneration of forests, through suitable harvesting methods and other means, is one of the major problems in each of our many important forest types. Successful establishment of a new forest requires specific knowledge of the seeding characteristics of parent trees or stands and the requirements of each species for germination and early survival. New information from research in several parts of the country has added significantly to knowledge in this field.

At the Southeastern Forest Experiment Station studies of the seeding habits of loblolly pine in relation to the natural reproduction of the species have been under way for a number of years. Recently, findings from these studies were rounded up in a station publication.

Although many types of forest landowners are interested in the means indicated for increasing loblolly pine seed production, the primary interest is probably that of growers of pulp timber. This is because pulpwood maturity comes at early ages when natural seed production is not abundant and appears often inadequate to secure well-stocked stands of reproduction promptly.

Scarification of the soil increased the catch of ponderosa pine reproduction eightfold in Montana. In California scarification and rodent poisoning resulted in a thirty-three-fold increase in seedling establishment following a heavy ponderosa pine seed fall. See germination on areas where sugar pine seed was raked into the soil was double that on untreated areas.

On the Argonne Experimental Forest in Wisconsin double-disking of the soil under a scattered and unproductive stand of hardwoods was followed by establishment of sugar maple and other hardwood seedlings at the rate of 18,500 per acre. An Athens-type disk was used at a cost of about \$6 per acre.

Although progress has been made in the application of mechanical methods of preparing ground to encourage natural reproduction, this is a field that needs further investigation. Combining mechanical methods with poisoning of competing vegetation needs particular attention.

Partial Cutting in Forest Stands

Partial cutting is often desirable to improve productivity by providing more growing space for choice trees, to anticipate and salvage natural mortality, to increase resistance to insects or diseases, or as a step in the process of obtaining natural regeneration. The intensity and frequency of such partial cuttings and the types of trees removed or left have a highly important effect on the future productivity of the forest. Research on the best methods of making partial cuts is receiving attention in several important types. A number of new findings during the past year resulted from this phase of the research program.

Growth rate of ponderosa pine can be doubled if stands are cut lightly every 10 to 20 years rather than cut heavily every 40 to 60 years as a practice formerly used. On the Coconino National Forest in Arizona this change from long to short cutting cycles made it possible to increase the annual cutting budget some 10 million board feet, providing an additional revenue to the Federal Government of about \$50,000 a year for stumpage and an additional yearly gross return of about \$550,000 to the lumber mills in the community dependent on the forest. These are practical results of research at the Fort Valley Experimental Forest in northern Arizona, where continuous studies have been under way for many years.

Windfall following cutting in the spruce-fir forests of the Central Rocky Mountains can be greatly reduced by harvesting them in very small clear-cut blocks or in narrow clear-cut strips together with light cutting of overmature, high-insect-risk trees in areas surrounding those which are clear cut. Earlier cutting methods almost always resulted in costly windfall and the windfall areas sometimes were the starting point of catastrophic Engelmann spruce bark beetle epidemics.

The Northeastern Station found windfall losses negligible on some 950 acres partially cut to increase resistance of spruce-fir stands to bud-

worm attack. The cutting method was made possible by several years of research to determine the types of trees most susceptible to damage by the budworm. These cuttings to aid budworm resistance have proved to be good business. Partial cutting, removing the large over-mature trees, costs less per cord of pulpwood produced than the traditional clear cutting. It takes twice as long to cut a cord of pulpwood from 5-inch trees as it does from 8-inch trees, and three times as long as from 15-inch trees.

In second-growth stands of Douglas-fir in the Pacific Northwest ranging in age from 27 to 108 years, studies are showing that thinning always speeds up the production of large-size trees and that it may increase over-all volume growth as well. Careful attention to logging techniques makes the thinnings pay their own way even in stands as young as 27 years. Thinnings from a 50-year-old stand are yielding substantial profits.

Timber Stand Improvement

In forests too young to produce merchantable products, or where operating profits are marginal, timber stand improvement work is good practice if the future yield and value of the timber can be sufficiently increased thereby. This phase of silviculture is becoming more important throughout the country as the acreage of second-growth timber increases and as rising prices and closer utilization of forest products make possible more intensive forestry. Research in this field is consequently being stepped up, with the result that new findings are becoming available each year.

It pays to release young southern pines from overtopping hardwoods. Ten years ago in a stand at Crossett, Ark., 1,200 young pines per acre were being suppressed by an overstory of low-quality hardwoods. All hardwoods two inches and larger in diameter were cut or girdled. Growth of the released pines has been so rapid that it was necessary to thin them last year. The returns from the pine stumpage removed in thinning was \$3.02 per acre. The cost of hardwood removal had been only \$1.51 per acre.

Studies in the control of unwanted hardwoods by cutting, girdling, poisoning, and burning are being made at a number of the forest experiment stations. The Southeastern Station rounded up its findings to date in a processed publication, *The Behavior and Control of Understory Hardwoods in Loblolly Pine Stands*.

Studies of the production of high-quality veneer peeler logs in southwestern Oregon indicate that if cutting continues at the present rate, it will exhaust the old-growth supply in 50 years. Two million acres of better-site second-growth stands should be put under management, including pruning, starting now at the rate of 17,000 acres per year to maintain the supply beyond that time. Additional effort will be needed to supply high-quality wood for other uses.

A new timber stand improvement bulletin for the Appalachian region was prepared by the Southeastern Station during the year and published as United States Department of Agriculture Miscellaneous Publication 693. This bulletin makes available to the forest practitioner the findings of 10 years' concentrated research by the station and by the Division of Forest Pathology, Bureau of Plant Industry, Soils and Agricultural Engineering, cooperators on the report.

Artificial Reforestation

Wherever natural regeneration has failed or has been made impossible by land-clearing operations, or by the clean-cutting or burning of large areas of forests, planting is necessary to establish a desirable type of new growth. Recent interest in rehabilitating devastated forest land and abandoned farm land has so increased the demand for planting stock that forest tree nurseries are unable to keep up with it. Research is finding ways to reduce nursery and planting costs and to insure better survival and growth in reforestation projects. Studies range all the way from seed selection and collection to cultural operations required in established tree plantations. The increased interest in reforestation has brought about a rebirth of interest in the possibilities of direct seeding. This subject also is receiving increased attention by research.

During the year the Forest Service published the *Woody-Plant Seed Manual*, a 416-page bound volume issued as United States Department of Agriculture Miscellaneous Publication 654. This manual brings together the results of many years seed studies at a number of the experiment stations—especially the Lake States Station where over a period of 20 years more than 4,000 tests were run on seeds of 270 species of trees and shrubs. The manual includes a general discussion of seeds and seed handling, and provides relatively detailed but concise information for 444 species of trees and shrubs of value in this country. Although authentic information from a great many published articles was drawn upon, the manual is in large measure based on information not previously in print.

Available information on geographic strains of Douglas-fir was brought together by the Pacific Northwest Station and published under the title *Better Douglas-Fir Forests From Better Seed* by the University of Washington Press. The California station drew up recommendations for sampling and testing the ripeness of sugar pine cones to insure 80-percent germination of the seed collected.

At the Lake States Station further work with herbicides proved that small weeds can be controlled successfully in conifer nurseries by careful application of mineral spirits at a substantial saving in labor costs. A second study showed how to correct excessive soil acidity built up in conifer nurseries.

The first extensive test of planting baldcypress in southern swamp has been made in cooperation with a lumber company. These tests show excellent early survival where the seedlings were large enough to keep their tops continuously above spring floods.

Tree Breeding

Genetics is as important to forestry as it is to agriculture. The development of fast-growing, high-quality, disease- and insect-resistant hybrid trees for planting will multiply the value of forest planting many times. In natural regeneration, the proper selection of seed trees can greatly improve the breed of the next and subsequent generations of forests. Forest genetics is a young science, but important findings are being made as research continues.

Among the pine hybrids recently developed by the Forest Service at the Institute of Forest Genetics in California are: a cross between Jeffrey and Coulter pines that is resistant to attack by the pine reproduction weevil which has wiped out previous pine plantings in Cali

fornia brushfields; a cross between eastern white pine and Himalayan pine that has already shown a high degree of resistance to the blister rust; and a cross between Digger and Torrey pines which may be valuable in dry, hot situations if it combines the good growth habit of Torrey with the fast growth and drought resistance of Digger.

At the Southeastern Station work has begun on the identification and selection of elite trees with superior characteristics of growth, form, and disease resistance. These trees are to be used for seed collections, vegetative propagation, and hybridizing in a program aimed to improve the breed of timber being grown both under natural reproduction and by planting.

Forest Mensuration

The measurement and estimation of the growth and yield of forest stands is essential to the proper conduct of the business of forestry. It is basic to all forest inventories and to the prediction and regulation of future timber yields. Research is developing new methods to make this measurement and estimation easier and more accurate, and is discovering the peculiarities of the growth and yield of different forest types.

At the Pacific Northwest Station a method was devised for predicting the future volume and density of Douglas-fir stands now in the reproduction stage.

An analysis of timber-sale scale books has shown that measuring sample trees is a practicable way to determine volume of timber cut on national-forest timber sales in the Northern Rocky Mountain Region. Generally, sampling should be confined to operations involving 1,000 to 2,000 trees or more. Usually the sampling method should include a complete tally of all larger trees (about the upper 10 percent) because these contribute heavily to the total volume. The estimated potential savings are 10 to 15 cents per tree, as compared with measuring all trees.

Naval Stores

Research in the naval stores field is concerned with the physiology of gum flow and methods of stimulating and increasing its yield, with the mechanics of gum harvest to make the operations more economical, and with the integration of naval stores and wood production.

On the Olustee Experimental Forest in Florida a first harvest cutting was made in a pine stand that had been turpentine-dipped according to improved methods—bark chipping and acid treatment. A quarter-million board feet of bark-chipped timber has been cut with a loss of less than 1 percent in lumber recovery due to turpentine-dipping. Pitch soaking was limited to a layer less than 1 inch deep and came off in the slabs. Pulping tests showed that pulp yield from bark-chipped butts was practically as high as from round pulpwood. Older turpentine-dipping methods made the lower part of the tree practically useless for wood products.

Among the accomplishments of naval stores research at the Southeastern Station are the following: A 2-percent solution of weed-killer, 2,4-D, was found to produce gum yields from slash pine about equal to those obtained with sulfuric acid, at least during the first year. Longer and larger tests will be needed, however, before commercial use can be recommended. Contrary to a widely held notion that tur-

pentine content of gum and grade of rosin would be lowered by the use of larger collecting cups, a cooperative study with the Bureau of Agricultural and Industrial Chemistry showed that these properties were not affected by the use of half-gallon cups which make possible a distinct increase in the efficiency of gum collection.

In response to insistent demand for equipment that will permit the use of chemical stimulation on high faces, a combination acid sprayer and puller was designed and tested, with the result that 17 biweekly acid-treated streaks on high faces produced 15 percent more gum than 34 weekly streaks not treated with acid. Physiological studies suggested that acid does not stimulate manufacture of gum in pines, but facilitates its flow.

Fire Research

Substantial reductions in fire losses are immediately apparent when systematic forest fire protection is introduced. The next step is to supply modern technology to the job, to make it more efficient and to further reduce fire losses. This calls for a continuing flow of new facts and methods that can assure constant improvement in fire-control work by all fire-protection agencies.

During the year the small group in the Forest Service engaged in fire research was able to report several significant accomplishments.

Fire-danger ratings based on methods developed by the Forest Service have proved of increasing value in managing the fire organization. In the Northeastern States the number of fires that occur has been found to be so closely proportional to the fire-danger ratings from day to day that the number of fires to be expected during any particular season can be closely computed. This makes possible for the first time a close check of the effect of fire-prevention measures taken, regardless of the weather conditions experienced.

Fire Damage to Watershed Lands

On the four national forests in southern California more effective use of fire-protection funds will be made possible by application of recent research results. The California Forest and Range Experiment Station, in a study of flood and erosion damage caused by forest and brush fires, found that such damage ranged up to \$700 per acre of burned area. It also found that the damages per acre increase rapidly with the size of the burn. Direct damages, such as destruction of property by fire, ranged from zero to \$1,500 an acre. Guided by this fire damage appraisal, the Forest Service can redistribute manpower and equipment on the four national forests to provide maximum protection for the areas of high damage potential. Also, fire-suppression strategy can be altered to minimize the total of suppression costs and damage. Where the damage potential is low, the area burned may be sacrificed in favor of ease of suppression and low costs. Where the potential is high, every effort will be made to hold down the area burned.

Besides demonstrating great differences in the value of southern California brushland, the study provides the first basis for actually evaluating fire damages to watersheds. Such damages have been recognized for many years but heretofore have been labeled "intangible." Other fire-protection agencies in the region propose to extend the usefulness of the results by comparing national-forest watersheds with similar watersheds outside the forest boundaries.

Use of Water and Wetting Agents

Systematic field tests during 1949 further demonstrated that chemical wetting agents have a definite place in forest fire fighting and can increase the efficiency of the job. Laboratory tests have shown a potential superiority for wetting-agent solutions of more than three times that of plain water, but it became evident that this superiority could easily be lost if improper techniques of application were used. The field tests showed particular advantages for wetting agents in suppressing flame quickly, in mopping up fire after it is under control and in pretreating unburned fuels in advance of an oncoming fire.

As more roads are built in forest country, and as more cutting is done, water can be used increasingly in forest fire fighting. But the forests do not have city hydrants, and other sources of water may be few and far between. Consequently water may cost up to \$1 a gallon at the hose nozzle on a forest fire. Ineffective use or waste of water under such circumstances is most unfortunate, but it does occur under the stress of a fire emergency.

Research on how to use water more effectively and on means of extending its effect through the use of chemicals and wetting agents might easily reduce the total of fire control costs and losses suffered from fire each year by 5 to 10 percent.

Beneficial Uses of Fire

Fire can be used beneficially in wild-land management, to accomplish specific purposes, if carefully applied and controlled. Demonstrated uses include reduction of fire hazards, preparation of seedbeds, control of certain diseases, elimination of undesirable species, and stimulation of certain desired trees and plants. Fire is a dangerous tool and should not be used until exact effects are known and successful techniques for complete control are established. Further progress was made in the study of beneficial uses of fire on longleaf and loblolly pine lands in the South.

Range Research

Ten years ago, the Forest Service began intensive grazing management studies on forest ranges in the piney woods of the Southern and Southeastern States. From the outset the importance of timber values was recognized, and the studies aimed at harmonizing cattle and timber production.

Studies in eastern North Carolina show that controlled cattle grazing has increased seedling establishment of pond pine from 50 to 500 percent on sites unburned for 2 to 10 years and increased the growth rate 23 to 67 percent for pine seedlings less than 2 feet tall. Grazing had the additional advantage of making the forest more accessible to foot travel and reduced light fuel at least 50 percent. This reduction of fire hazard was emphasized by three separate wild fires that resisted control efforts until they reached the grazed experimental ranges.

In a study conducted cooperatively with a local lumber company in southwestern Louisiana, firebreaks logged, disked, fertilized, and seeded with desirable forage species not only provided nutritious range forage for cattle but the firebreaks were more efficient because the grazing kept the vegetation uniformly grazed to within an inch of the ground.

Killing scrub oaks and other low-value hardwoods with Ammate in central Louisiana increased grass production on experimental plots to 1,531 pounds per acre compared with 804 pounds on check plots. Cattle grazed the released areas more heavily, and the growth of the grass was faster and furnished succulent and nutritious forage longer into the summer.

Reseeding Range Lands

Ponderosa pine forest lands constitute two-thirds of the total summer grazing capacity in eastern Oregon and Washington. Logging on these lands has a marked adverse effect on herbage available as livestock forage. Studies on several logging operations showed that the immediate effect was the denudation of 22 percent of the ground with an additional 9 percent covered by slash. Such a reduction of nearly one-third in the area available for producing forage for livestock substantially lowers the grazing capacity. This requires drastic adjustment in stocking on the logged-over lands to prevent damage to the remaining forage through overgrazing. Research, however, has developed successful methods of reseeded logging roads, skid trails and landings in this region, and such reseeded is strongly recommended.

Reseeding a mixture of crested wheatgrass, smooth brome, and sweetclover on submarginal abandoned cultivated fields in the ponderosa pine zone in the front range of central Colorado produced a per acre gain of 115 pounds of beef and provided 2 heifer months of grazing for each acre. Moreover, the reseeded species grow early in the spring, thereby adding another month to the customary 5-month season for native grasses.

In the Bitterroot Valley in western Montana, it has proved profitable to convert submarginal abandoned plowed land infested with the annual cheatgrass to desirable forage species by using an intermediary step in which wheat or barley is first grown for 1 year. On one area a grain crop of 10 to 15 bushels per acre and 1 year of improved grazing after establishment of crested wheatgrass paid for costs of machine operation, labor, seed, fence construction, loss of grazing value during an 18-month period, and interest, and netted \$4.55 per acre besides. Crested wheatgrass was drilled directly into the grain stubble. On many sites intermediate wheatgrass is even more productive than crested wheatgrass. This practice of converting such lands is believed applicable to vast acreages of cheatgrass ranges in the upper Columbia and Missouri River Basins.

Many subalpine ranges in central Utah at elevations around 10,000 feet are seriously deteriorated because of past use. Their restoration through reseeded both for forage production and for watershed protection has received intensive study. The short frost-free period (approximately 80 days), the depleted and eroded soils, strong drying winds, and sudden below-freezing temperatures in the growing season all hamper the establishment of reseeded grasses. Research shows that adaptable strains of slender wheatgrass, mountain brome, and smooth brome will produce satisfactory stands when planted in late spring. Such studies are contributing essential basic information for successful reseeded programs on national forests and other intermingled lands to restore productivity to these important range-watershed areas at high elevations.

Control of Undesirable Plants

Progress is continuing in studies of the use of chemicals to control undesirable plants on western ranges and to improve the forage production of the palatable and nutritious species. Spraying with 2,4-D has shown promising preliminary results in killing big sagebrush, silver sagebrush, and rubber rabbitbrush in California and Utah.

Formulations of 2,4-D have also proved useful on summer ranges in western Colorado to control the poisonous orange sneezeweed. In Colorado alone the plant causes an annual loss to wool growers of approximately \$150,000. Additional investigations indicate that drilling adapted grasses into sprayed sneezeweed stands will further benefit the range by providing more forage and at the same time retarding the reestablishment of sneezeweed.

Forest Influences

Various circumstances have combined to increase the value of forest-influences research and to speed up application of its results. Among these are the fast-growing interest in the watershed aspects of river-basin planning and development, and the Presidential appointment of a Water Resources Policy Commission to consider the interrelated problems and needs of the Nation's soils, forests, and waters and to recommend national policies for their effective utilization and conservation. New York City's widely publicized water shortage only echoed the mounting anxiety over water supplies everywhere and directed attention to watershed conditions as a key to improving the present unsatisfactory situation.

Watershed Research

Watershed research is contributing in many ways to these developments. It is adding to a better understanding of the basic concepts of soil-water relations, and is furnishing information vital to the development of sound policy. It is also providing valuable quantitative information on water flow and the land conditions and practices which affect the yield, behavior, and quality of stream flow.

In the Delaware River Basin, to which New York has turned for relief from its water shortage, preliminary investigations of tributary drainages have already brought to light marked differences in the yield and distribution of stream flow between heavily and lightly forested watersheds. Thus the upper Lehigh River watershed—90 percent forested—yields more water per square mile and fluctuates less between the extremes of high and low flow than the closely similar upper Lackawaxen basin, which is only 38 percent forested. The discharge of the Lehigh is clearer than the Lackawaxen's. The heavy surface runoff with attendant soil losses from the Lackawaxen basin during early spring snowmelt or rainfall is attributable to the deep, firm frost in the soils of pastures and over-grazed woodlands. By contrast, well-forested areas in both the Lehigh and Lackawaxen exhibited no deep, firm freezing, and no surface runoff or erosion. The unfrozen soils permitted the water to infiltrate, thereby delaying its movement into the streams.

These investigations show how essential it is to pay close attention to watershed conditions in planning for the water-supply requirements of municipal and industrial areas.

How to trace back to the watershed the sources of water supply often a baffling problem. Investigations in southern California show that in some areas stream flow may reflect only a portion of the water yield after losses by evaporation and transpiration have been accounted for. Measures on test areas indicated that stream flow represented only 4.6 area inches out of a total calculated water yield of 17 inches, the remaining 13 inches going directly underground by percolation through the soil and rock mantle. A subsequent year's investigation confirmed the first. This time calculations showed that 14 inches went directly underground for storage in the deep valley sand and gravels. The results of this study will permit better estimates of water yield than stream-flow measurement alone, wherever the surface is underlain by permeable rock strata, as in southern California.

The importance of fire control as a factor in replenishing underground water supplies is emphasized by experiments in the Sierra Nevada mountains. During 1 year, percolation under an unburned ponderosa pine cover was 28 inches. On burned plots, however, the amount of water percolating through the soil amounted to only 7 inches. Similarly on plots in woodland-chaparral cover, percolation before burning was over 42 inches, in contrast to only 23 inches after burning. Damaging surface runoff correspondingly rose from zero on unburned plots to nearly 24 inches on the burned plots.

Muddy water is costly water. To make it useful requires expensive treatments to settle out unwanted material. In addition, the sediment it carries reduces reservoir storage capacity, clogs intakes, and causes rapid depreciation of turbines, pipes, and other facilities. These are serious matters to municipalities, irrigationists, and industries everywhere. The relation between land abuse and unsatisfactory water flow conditions, including muddy water, is shown by 10 years' observation of the effects of continued overgrazing of Appalachian Mountain forests. Cattle trampling so compacted the soil that by the eighth season its infiltration capacity was reduced 96 percent, and the accumulation of surface water was increased at least 625 times. As a result each storm produces heavy and rapid runoff which washes the soil particles into the streams.

Flood Control Surveys

The Department of Agriculture is making a comprehensive investigation of land and water resources on the Columbia River Basin and adjacent Pacific Northwest coastal drainages. Flood control survey personnel from several Forest Service experiment stations have joined forces to concentrate on this large and important area. The basic findings on soil and vegetation and their use as they affect flood flow, stream-flow distribution, and erosion and sedimentation rates will contribute materially to a sound over-all program for the utilization of the region's land and water resources.

The adjustments necessitated by this and other special work have temporarily delayed the completion of flood-control survey reports authorized by Congress on certain watersheds. However, two reports were submitted to the Department by the Forest Service during the year, one on part of the Mojave River watershed in California, and the other for the Sevier Lake watershed in Utah.

Forest Economics

During the fiscal year 1950, field inventory work for the national survey of forest resources covered about 22 million acres of previously unsurveyed lands in California, Montana, Indiana, Kentucky, Tennessee, West Virginia, Maryland, Pennsylvania, and New York. Resurveys of areas initially inventoried during the thirties covered an additional 17 million acres in Oregon, Washington, Idaho, Minnesota, Wisconsin, Michigan, Arkansas, and Florida. In about half these states cooperating public and private groups contributed financial or other assistance. Final statistics on forest land and timber resources were released for Florida, South Carolina, Mississippi, Missouri, West Virginia, Illinois, New Hampshire, and Vermont. A generalized forest-type map of the United States was lithographed and distributed.

Since the Forest Survey was begun in 1930, a total of 423 million acres of forest land has been covered by initial surveys, leaving 201 million acres yet to be covered. Slightly more than a third of the area initially covered prior to the war has been resurveyed during the past years to bring the information up to date. In addition, surveys of the use of forest products by railroads and in manufacturing have been under way as a basis for estimating future needs. The complex problems of requirements or future needs for forest products are among the most important phases of the Forest Survey.

Legislation in the Eighty-first Congress (Public Law 128, June 25, 1949) increased the authorization for both initial surveys and resurveys as a means of making and maintaining a continuous and comprehensive timber inventory as part of the Nation's forest-conservation program. Under this legislation it is planned to accelerate and intensify the Forest Survey to provide more quickly to forest industries, public agencies, and others comprehensive and reliable facts on the country's timber resources.

Special Economic Investigations and Reports

A variety of special reports on important forestry subjects was prepared for various agencies. These included an appraisal of the timber situation for the President's Council of Economic Advisers, reports for the National Security Resources Board and the Munitions Board on availability of supplies and requirements for various forest products, statements on the pulpwood resource situation for the United Nations Food and Agriculture Organization and the Economic Cooperation Administration, and several papers and reports for international conferences dealing with conservation and forestry. Cooperative projects are under way with defense agencies concerning military requirements for forest products and other matters.

Other economic investigations concerned with the management of forest lands are providing criteria for resolving questions relating to optimum stocking of forest stands, the financial maturity of individual trees, and the best utilization of trees for different products. A study to appraise the feasibility of pulp-mill development in Montana has begun. This will evaluate timber supplies and certain other factors that determine the possibilities for local industry. The pulpwood-supply situation in the Lake States also is being intensively studied to determine possible ways of overcoming the increasing difficulties of wood procurement.

In the marketing field, recently completed studies of Christmas-tree marketing in the Northern Rocky Mountain region have developed a system of grading rules and have indicated other measures to increase marketing efficiency. Studies are also under way in eastern region under the Research and Marketing Act, aimed at developing more effective organization and procedures for marketing farm woodlot products. These have included preparation of directories of timber buyers, design and testing of grade specifications, and assistance in developing price-reporting services for timber products.

Consultation with State officials on problems of forest taxation has continued and a new study has been initiated to determine the effectiveness of special State forest tax laws in encouraging forestry, with particular emphasis on the yield-tax laws.

Forest Products

The Forest Service's research program in forest products is directed toward more complete and efficient utilization of the forest crop. It is contributing to lower costs and better serviceability of existing wood products, and to development of new products. The work is centered at the Forest Products Laboratory, Madison, Wis. Following are some of the past year's activities.

New Pulping Process

A new process for pulping hardwoods was discovered at the Laboratory. In mill-scale trial runs, container-board papers were produced from pulp so processed that compared favorably with the regular commercial output of the mill. The process offers distinct advantages, being simpler, less costly, and more efficient from the standpoint of raw-material conversion than older chemical pulping processes. Essentially the process consists of treating hardwood chips—aspen was used in the mill tests—with caustic soda and then putting the softened chips through a grinder. Up to 90 percent of the wood is thereby transformed into pulp, waste and chemical effluent being nearly eliminated.

Laminated Construction

Increased scarcity of large solid structural timbers has brought greater demand for glued-laminated beams and arches fabricated of material from standard lumber grades. While these could be fabricated readily, assigning working loads has been difficult because defects are confined to single laminations and the position of these defects in a built-up member is unknown. However, on the basis of a selection of typical material from standard lumber grades, a random selection of this material, and a statistical analysis of resulting strengths, it is now possible to assign accurate working stresses to such members and thus to use the materials safely and economically. The presence of knots in the laminations was found to cause no progressive deterioration in the quality of the glue joints.

Wood and Plywood Freight Cars

Lower-cost and lighter freight cars are made possible because of design criteria for wood and plywood that have been developed through research at the Forest Products Laboratory. A large manufacturer of railway cars has used these criteria to design a boxcar,

refrigerator car, and a lumber car. The cars are all wood—the only materials other than bonding agents are steel couplings embedded in wood, steel plates in contact with the trucks, and steel door frames. No nails, screws, or metallic fastenings are used. The refrigerator car has successfully passed coupling and road tests. Heat-insulation tests show a great improvement over the usual design. The boxcar and lumber car are being built and will be tested.

Duo-Kerf Saw

A new and improved type of saw has been developed, as an outgrowth of basic research at the Forest Products Laboratory on exactly what takes place when the teeth of a circular or band saw cut into a log. A new duo-kerf principle in saw tooth design is involved. Tests made thus far indicate that the use of this principle reduces the power required for sawing by 20 to 25 percent, produces a smoother surface and hence less shaving loss, and permits the use of a thinner saw, thereby reducing the waste in sawdust. Because of the reduced stress on the saw, greater accuracy in sawing should be possible, thereby reducing the planing allowance necessary.

White Pocket Lumber

Much overmature Douglas-fir timber in the Pacific Northwest is infected with a fungus that causes a pitting called white pocket. This fungus is halted when the lumber is cut and seasoned. The usefulness of white pocket lumber was determined for construction purposes, especially in housing, as an aid in salvaging it. It was found to be entirely satisfactory for house parts like sheathing, subflooring, and roof boards, and for decorative material in panels and cabinet work where high strength is not essential. Properly selected, it was found suitable for structural parts like studding and joists. As a result of this work white pocket material is already finding a market.

Rate of Heat Penetration in Wood

Research on heat conductivity and on the rate of temperature change in wood has made available to manufacturers important basic information relating to the heating of wood from hot-press gluing operations, preservative treatments, veneer cutting, and other processing work. This information is comparable with that available for metals and other structural materials, and contributes to basic engineering and processing knowledge.

TROPICAL FORESTRY

The Tropical Region of the Forest Service administers the Caribbean National Forest, maintains the Tropical Forest Experiment Station, serves as a center for the exchange of forestry information among Latin-American countries, and cooperates with the Government of Puerto Rico in forestry matters. The Director of the Region, by cooperative agreement between the Secretary of Agriculture and the Puerto Rico Commissioner of Agriculture and Commerce, also serves as Director of the Insular Forest Service. This arrangement has resulted in a harmonious coordination of all forestry activities in Puerto Rico.

The Caribbean National Forest in Puerto Rico, created in 1903, and under technical management since 1917, is one of the most intensively

used areas in the national-forest system. Its greatest over-all value is the protection it affords to the headwaters of streams which supply some of the island's most important reservoirs. The Forest also supplies saw timber on a sustained-yield basis, round posts and poles for light construction and fence building, small railroad ties, and large quantities of cordwood for the manufacture of charcoal. Last year 358 sales were made, involving 634,000 board feet of sawn lumber, round timbers, and fuel wood, for which the contractors paid \$10,900. Through forest management, the natural timber stands are being greatly improved in quality for future cutting.

La Mina Recreation Area in the Caribbean National Forest is heavily used; as many as 4,000 persons visit this area on a week end. A smaller recreation project, the Dona Juana on the Toro Negro Division of the Forest, also is popular, with as many as 1,500 week-end visitors.

The social benefits of the Caribbean National Forest are substantial. The Forest helps to meet the unemployment situation on the island. Work on the Forest and in the harvesting and processing of the forest products provides several thousand man-months of employment. A number of families are allowed the use of small parcels of land under permit within the Forest, where they grow a large part of their subsistence.

Speeding Growth

Investigations in the tropical forests of Puerto Rico have shown that virgin rain forests contain from 4,000 to 4,500 cubic feet of timber per acre, and are thus comparable to many hardwood stands in the temperate zone. Growth in these rain forests is slow, averaging not more than 25 cubic feet per acre yearly, because of intense competition. There are many suppressed trees. Experiments in silvicultural improvement indicate that with cuttings to reduce the density, tree growth can be more than trebled. Moreover, the first cutting removes nearly all of the inferior trees for charcoal wood, leaving a better stand for the future.

Investigations in regeneration during the year brought to light species new to Puerto Rico, primavera, which is making very rapid growth in plantations. It is a valuable Central American furniture wood. Other species that are growing rapidly include mahoe, *Casuarina lepidophloia*, *Eucalyptus robusta*, teak, and broadleaved mahoe, any. Twelve-year-old plantations of eucalyptus, teak, and mahoe are now in need of light thinning.

The Tropical Forest Experiment Station participated in a 3-day conference on coffee research with representatives of several Government agencies, coffee growers, and industries. A comprehensive coffee research program was proposed, including several forestry investigations, such as determination of the optimum spacing of both shade and coffee trees, the best tree species for coffee shade, improved methods of shade management and utilization of the shade trees, the value of windbreaks in coffee plantations, and the best trees for this purpose.

Some 600,000 acres in Puerto Rico is classed as potential forest land. About 180,000 acres of this is used for coffee growing, which properly managed is good forest practice. Growth on the remaining 420,000 acres is probably 25 percent of what the land could produce under good management. Much of it is idle or abandoned land.

without forest management of any kind. Much of it needs prompt rehabilitation and care for the protection of watersheds above the island's reservoir systems, where large investments have been made for hydroelectric power, irrigation, and industrial and domestic water supplies. Probably not less than 200,000 acres should be reforested.

Forestry is clearly a part of any sound land use in the mountain areas of Puerto Rico. If forestry is not attractive to the owners of these lands, it should be made so by public aid, or the lands should be acquired by the public and managed in the public interest.

Latin-American Forestry Cooperation

During the year, the Forest Service's Tropical Region furnished forestry and research information in response to requests from nearly all Caribbean countries, especially Martinique, French Guiana, Surinam, Trinidad, Honduras, and Venezuela. The Director attended the Latin-American Conference on Forestry and Forest Products at Lima, Peru, as the official observer for the United States Government.

The Region gave a 4-months' training course in forestry and forest administration to a representative of the Cuban Government. Additional similar training courses are planned under the Point Four program.

PERSONNEL

During 1950, scientific management was given new emphasis throughout the Government service as a result of the report of the Commission on Organization of the Executive Branch of the Government and the subsequent Executive Order No. 10072 issued by the President. As a basic step in reexamining its management system, the Forest Service revised its correlated standards and allotment base for the regional, national forest, and ranger district levels. This involved review and revision of objectives, standards, methods, procedures, and organization, with the aim of improving efficiency and economy in all Forest Service operations.

A Service-wide conference of scientific management personnel, the first in several years, was held in Ogden, Utah, to discuss and reexamine the Forest Service's management system in the light of recent developments. Also, several surveys by outside experts were initiated to study various Forest Service policies, procedures, controls, and accomplishments. These surveys were requested by the Forest Service in order to obtain an impartial appraisal of its program operations.

Recruitments and Retirements

Twenty-nine new junior-professionals were added to the Forest Service rolls during the year—18 from the forest option list of civil service eligibles, and 11 from the range option list. Replenishment of the junior-professional ranks during the period 1946-48, together with the tight financial situation in 1949, was primarily responsible for this unusually low number of new appointments.

During the year 68 employees retired, at an average age of 61.8 years and an average of 31.5 years of service. Forty-six others were retired for disability, at an average age of 54.3 and an average service of 11 years.

The Forest Service assisted the Civil Service Commission in develop-

ing 14 "series" of civil service class specifications applicable to different grades and kinds of Forest Service positions. This will greatly facilitate position classification and related personnel work.

Two "interest" or "preference" tests were added to the battery of tests given junior-professional recruits, with the aim of finding further indications helpful to more effective career planning and placement for personnel.

Training

Most of the training camps conducted by the Forest Service for new technical personnel placed emphasis on training in administrative techniques and resource management, often using a typical ranger district for discussion, analysis, and working out of problems on a group basis. In some of the regions where there is much winter-sports activity on national-forest areas, special training in skiing, winter rescue, avalanche control, and administration of winter recreation areas was given. Ranger training camps which had been dormant or greatly reduced during and since the war were resumed in some of the regions. At the request of forestry officials of one State, the Forest Service conducted an area training seminar for State officers, fire wardens, and other forestry employees.

Awards

The National Safety Council awarded its President's Medal to three members of the Forest Service for saving lives by artificial respiration. Recipients of the medals were Bliss Paul, fire crew foreman, Lassen National Forest, Calif.; Max D. Williamson, forest ranger, Tahoe National Forest, Calif.; and Edison L. Kilgore, Ouachita National Forest, Ark. The National Ski Patrol awarded its Purple Merit Star for the saving of life to Howard C. Lee, forest ranger, Arapaho National Forest, Colo.

Foreign Visitors

Forest Service people gave considerable time during the year to official foreign visitors who came to the United States for information or training in forestry. Training was given to six Korean foresters and one each from Germany and Japan, sent here under various Government auspices. One intern each from Cuba and Mexico undertook a year's training under awards of the Secretary of Agriculture. Five Turkish foresters were sent by their government for 2 years' forestry study, both with the Forest Service and at American forest schools under general Forest Service guidance. A sixth Turkish forester arrived at the end of the year to start similar training.

Although these visitors come primarily to seek information and training in the United States, the Forest Service feels that the exchanges of information and development of international understanding that results have been of distinct value to its own people.

STATEMENT OF RECEIPTS AND EXPENDITURES

National Forests

Receipts from the national forests deposited to the Forest Reserve Fund during the fiscal year 1950 amounted to \$33,594,614. In addition there was collected \$868,324 from revested Oregon and California

Railroad Co. grant lands and \$77,148 from the Tongass National Forest in Alaska, both of which were deposited in suspense pending proper disposition, making a total of \$34,540,086. Of the Forest Reserve Fund receipts \$29,379,217 was from timber; \$3,385,004 from grazing; and \$830,393 from special land uses, water power, etc. Of the amount credited initially to the Forest Reserve Fund \$71,930 is returned to Arizona and New Mexico on account of State school lands within national forests; \$43,548 is paid to Minnesota representing three-fourths of 1 percent of the appraised value of lands in the Superior National Forest described by act of June 22, 1948 (Public Law 733); \$137,838 has been appropriated for acquisition of national-forest lands, and \$700,000 for range improvement. Distribution of the remainder is as follows: Paid to States for benefit of public schools and public roads of the counties in which national forests are situated, \$8,343,010; appropriated for expenditure by the Forest Service for roads and trails within national forests, \$3,338,485; balance to the general fund of the United States Treasury, \$20,959,803.

Expenditures for national-forest operation, protection, and management were \$37,307,880. Additional expenditures from appropriations for forest roads and trails amounted to \$12,173,110, and for acquisition of national-forest land, \$562,620.

Aid to States

Forest Service expenditures for cooperation with States and private agencies in fire control, planting, and assistance in forest practice were \$9,976,119.

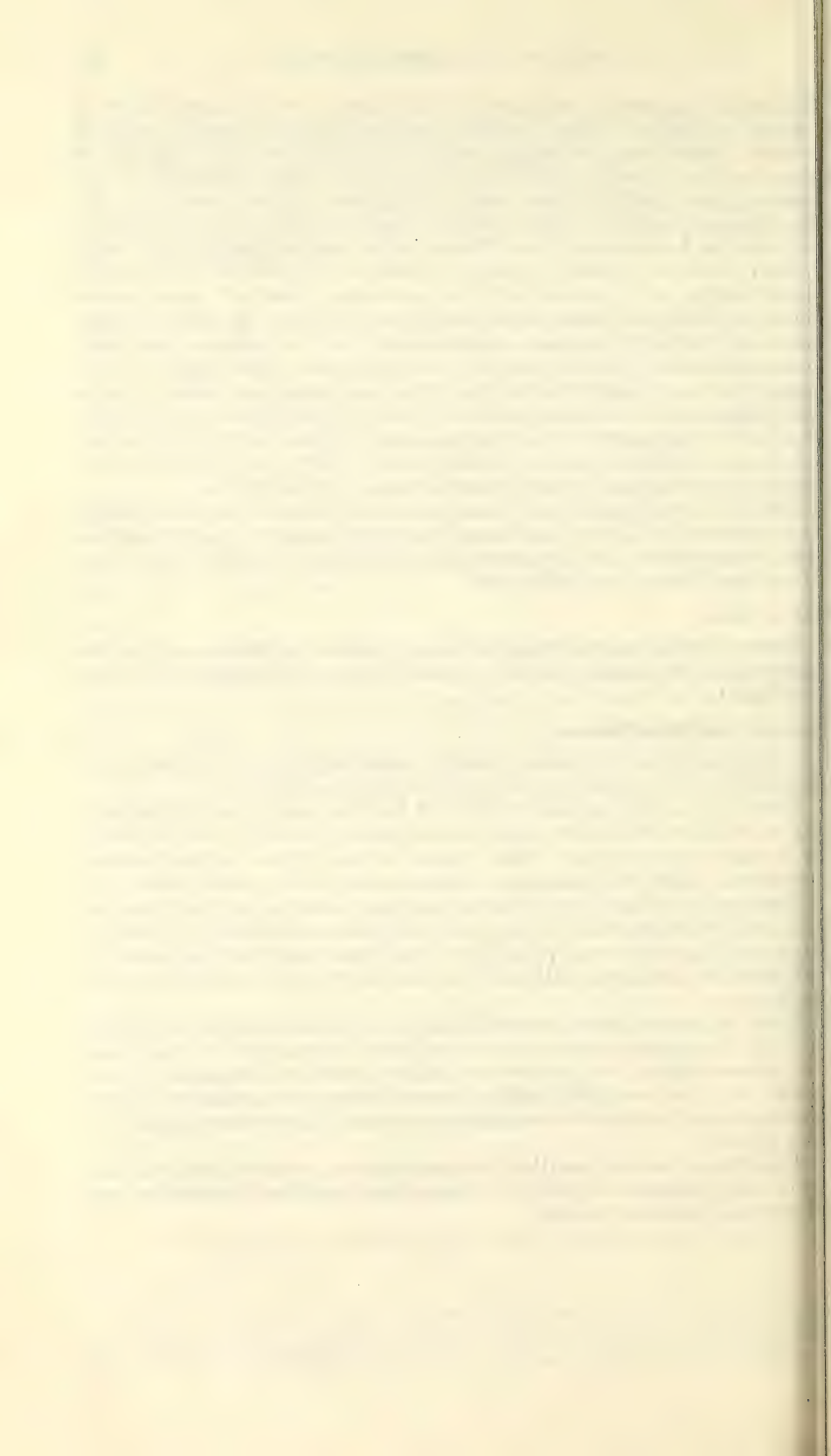
Research and Miscellaneous

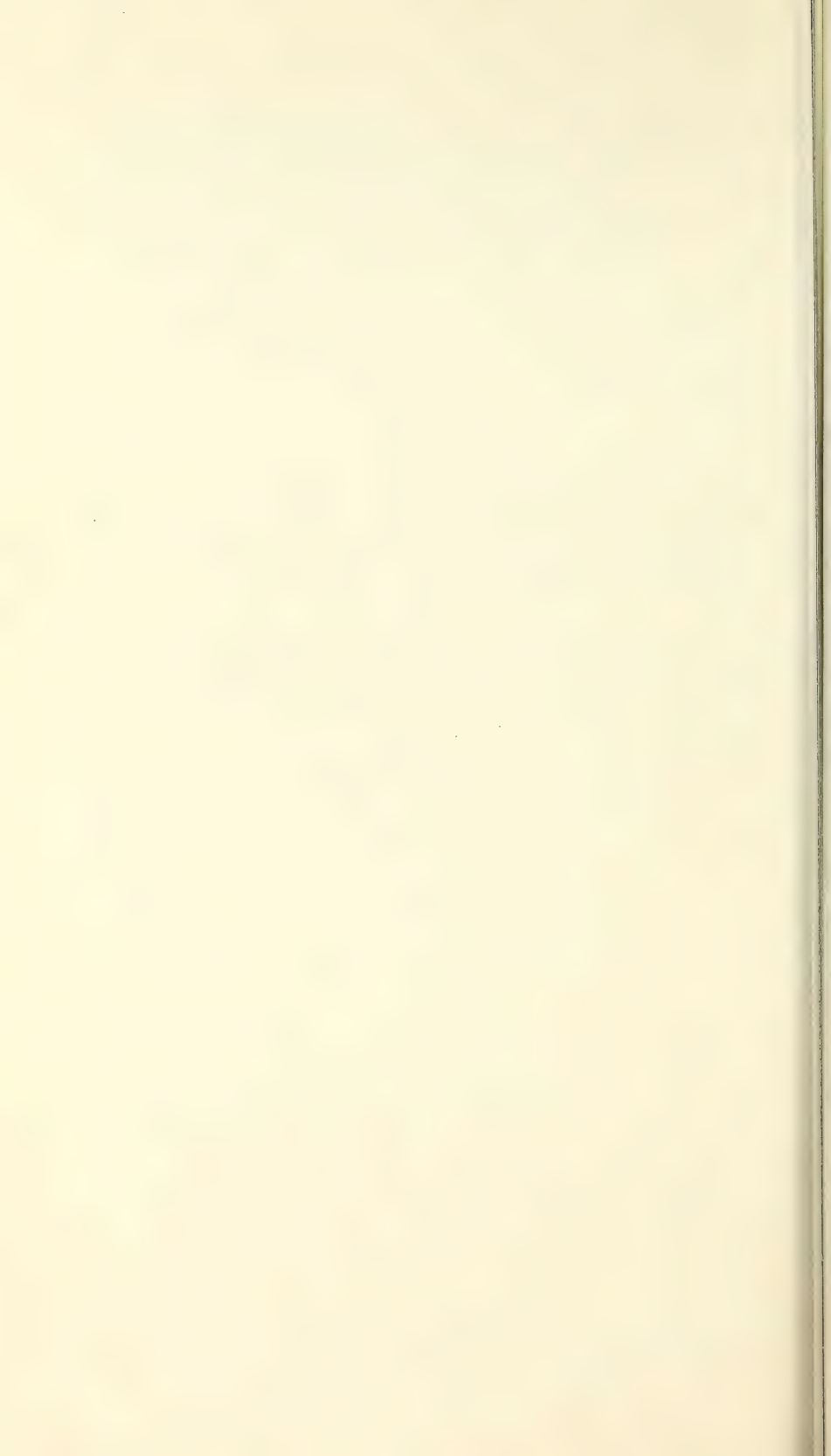
Expenditures for forest research were \$5,211,982; for flood control \$1,749,246; general administrative expense \$668,784.

There was also expended \$6,093,782 for fire control, slash disposal, improvement work, timber-stand improvement and other work financed by outside agencies and from funds derived from national-forest resources. Also for emergency reconstruction and repair, \$2,057,190. Services for other Government agencies involved expenditures of \$745,140, including \$124,746 for the Production and Marketing Administration (Agriculture); \$82,200 for the Department of the Interior; \$273,948 for the Army; \$176,633 for the Navy; and \$87,613 for other agencies.

Total net expenditures were \$76,545,853. In addition, expenditures for which appropriations were reimbursed amounted to \$5,354,767 and expenditures from proceeds of sale of parts and equipment purchased in prior years, \$491,462. Expenditures were accounted for by objective and functional classifications under 113 separate appropriation titles.

The Forest Service handled the naval stores conservation program, involving payment of \$274,156 from funds of the Production and Marketing Administration.





**REPORT OF THE CHIEF
OF
THE FOREST SERVICE
1951**

**NATURAL ENEMIES
OF TIMBER ABUNDANCE**



UNITED STATES DEPARTMENT OF AGRICULTURE

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., September 15, 1951.

HON. CHARLES F. BRANNAN,
Secretary of Agriculture.

DEAR MR. SECRETARY: If our forests are to continue productive, if they are to keep on providing their many benefits and services to the people of the United States, protection of these forests from needless damage by their natural enemies is of basic importance.

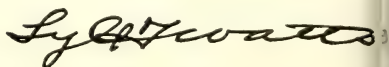
Fire is a familiar natural enemy of the forests. Many people are not aware, however, that insects and diseases cause a greater loss of merchantable timber each year than does fire. A fungus disease has all but wiped out one of our finest native trees, the American chestnut. Another disease threatens our valuable white pine. A bark beetle is threatening Engelmann spruce stands throughout the central Rockies, and a budworm is a threat to a vast amount of valuable timber in the Northeast and Northwest. In epidemic outbreaks, such pests can cause tremendous destruction.

During the past 40 years we have made substantial progress in reducing forest fire damage. We have not made corresponding progress in the reduction of losses from forest insects and diseases. Such losses, indeed, have increased. We now have enough technical knowledge, however, to accomplish effective protection against some of the serious insect and disease pests. For others, such as "little leaf" of the southern pines and "pole blight" of the white pine in Idaho, we do not. Expanded research, to produce knowledge that will make possible more effective and economical control, is badly needed.

For these reasons, I wish to call special attention to the problem of forest insects and diseases in this report. It is important that we recognize the menace of these pests, and that we give adequate attention to their control.

Protection of the forests from their natural enemies is a first essential in the national program of forestry. It is equally essential that we have good management and wise use of the forest resources. Man, if he handles the forests unwisely and exploits them destructively, can be their greatest enemy.

Sincerely,



LYLE F. WATTS,
Chief, Forest Service.

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**Report
of the
Chief of the Forest Service
1951**

NATURAL ENEMIES OF TIMBER ABUNDANCE

We Need Plenty of Timber

Our country needs an abundance of forest products. We in the United States use about 40 percent of the world's total output of lumber and well over half of the world output of pulp and paper products. Our consumption of all wood products per person is more than three times the world average.

This high per capita consumption of wood in the United States reflects our high standard of living. A plentiful supply of forest products, indeed, is one of the requirements of our standard of living. We require enough wood to meet our continuing demands for new houses, for newspapers and books, for rayon dresses, photo film, and hundreds of other useful things that come wholly or partly from trees. Wood is one of the important raw materials of industry; and an abundant and continuing supply of it is therefore one of the requirements for a high level of industrial production and employment. At the start of World War II, some of the war production planners were thinking of wood as a handy substitute for some of the critical war materials. Before the war ended, they were wondering where they could find substitutes for wood. That mistake must not be made again. Forest products are now classed among the essential materials of the current defense program. They are needed for our national security.

The forests have recreation values of great importance, too. Still another forest "product" is fish and game. Forest ranges in the West and South furnish grazing for millions of head of domestic livestock. By far the most important service of the forests in many parts of the country is to protect the watersheds and thus to reduce the danger of floods, erosion, and sedimentation, and to help provide dependable supplies of water for irrigation, power, and domestic use.

This year's report gives special attention to natural enemies of the forest which threaten all these great values and services. The most important natural enemies are insects, diseases, and fire. It is desired especially to call attention to the destructive insects and diseases. Most persons know what fire can do to the forest. Many are not aware that insects and diseases cause even greater losses.

The Resource We Once Had

What is now the United States was once endowed with a forest wealth almost beyond imagining. Forests covered nearly a billion acres, stretching almost unbroken from the Atlantic seaboard to the Great Plains, and over large areas at the higher elevations of the Rocky Mountains and the Pacific Coast regions. There were hundreds of different kinds of trees, many of them producing excellent wood for various uses, many of them growing to great size.

For more than 2 centuries after the first colonists came to American shores, the main concern was to push back the forest to make room for settlement. The forests provided the material to build farm and village homes and furnishings. Enormous quantities of timber were wasted as the settlers cleared land for farming. Then, as the cities grew and industries developed, a great period of lumbering began. Exploitation of the forests was on a Paul Bunyanesque scale; burl loggers performed giant feats with ax and saw to "let daylight into the swamps"; great river drives brought logs by the thousands to the mills to meet the ever-increasing demands of a growing Nation for lumber. Even when all the merchantable timber in one locality was cut out and the local sawmill had to close down, there was always more timber over the next hill. High-grading of the choice trees left many forest stands in poor condition. Clear cutting followed by uncontrolled fires devastated the forest growth on millions of acres.

The forests contributed mightily to the development of our Nation. They built great cities, great industries, and great fortunes. Timber was used lavishly, and wastefully, because it was abundant and cheap.

This country grew up in an atmosphere of abundance. Our democratic way of life has thrived on it. And despite some of the pressure of undersupply now being felt, we still should think in terms of regaining and maintaining abundance.

Nothing is gained by lamenting the past waste in the use of our forest resources. What we must deplore is that forest resources were used, and still are being used, with too little thought of replacement or perpetuation of the supply. To have permanent forest abundance we must put our land to work.

Forests on the Downgrade

Following World War II, the Forest Service made a reappraisal of the forest situation in the United States. The facts brought together in this reappraisal showed very definitely that our total forest resource is in unhealthy condition, that we are heading for a period of tighter supply of some of our needed forest products. In fact, we are already experiencing shortages of certain kinds of forest products, such as large-size, high-grade lumber and timbers, and the kinds of wood needed for some of the specialty uses. Lumber prices have skyrocketed to some three times what they were 10 years ago. They have risen much faster than the prices of other building materials, reflecting in part at least the fact that our supply of good quality, readily accessible merchantable standing saw timber is getting scarcer. Suitable new locations for large-scale logging operations are increasingly hard to find.

We are not growing saw timber as fast as we are using it. Saw timber is timber big enough and of the right kinds to make lumber, whether used for that purpose or not. Eighty percent of all timber products are cut from trees of saw-timber size. The reappraisal showed that the total annual drain of saw timber is exceeding the total annual growth by 50 percent. That was on the basis of the 1944-45 rates of drain and growth. Drain includes timber cut for commodity use plus losses from fire, insects, diseases, etc. Ninety percent of the total drain is "commodity drain"—timber cut for use.

A decrease in the volume of saw timber was to be expected, of course, as old-growth forests were being replaced by second-growth. There is a near balance between drain and growth for all timber, including that less than saw-timber size. But most of the drain is in saw timber, particularly the better softwoods, whereas much of the growth is in small, low-grade trees and inferior hardwoods. We are eating heavily into our forest capital of good-quality growing stock.

We have in the United States about 460 million acres classed as commercial forest land, bearing or potentially capable of growing merchantable timber. On the average, the annual saw-timber growth on this land is only about half of what it could and should be. The quality of the timber has deteriorated over wide areas; millions of acres now bear only low-value, scrubby trees. Much of the land is understocked; millions of acres of forest land capable of producing good timber crops are very poorly stocked.

For 300 years, our Nation has obtained its timber largely from the virgin forests that nature provided, or from volunteer second-growth on cut-over or burned-over lands. Only within the past half century has an appreciable effort been devoted to growing timber as a crop. Now that the end of the virgin timber is in sight, we shall have to rely more and more upon what we grow.

We face a difficult task if we are to meet forest products needs during the current defense emergency without further seriously weakening our forest resource base. Even more difficult will be the job of building up the timber growing stock necessary to assure a sustained, abundant timber supply for the future.

Protection Is an Essential Step in Forestry

Our forests have enemies that constantly threaten them. Fire each year takes a tremendous toll, destroying billions of young trees and injuring bigger ones, killing wildlife, blackening recreation areas, and marring watersheds. Windstorms sometimes lay low the trees over large tracts; ice storms may do great damage. Numerous insects and diseases attack trees and in many areas they cause greater losses of timber than do fires.

We are earnestly concerned these days about protecting our country from dangers that threaten us from the outside. But we must not overlook enemies within our own borders. Adequate protection of our forests from their natural enemies will save a very great volume of timber. It will help greatly to conserve water and reduce floods.

Protection is not the complete answer to the forest problem. But it is an essential step in building up and maintaining our forest resource, one of the basic resources upon which our Nation's strength and welfare depend.

PROTECTING THE FORESTS FROM FIRE

In the decade that ended in 1950, more than 1,824,000 forest fire occurred in the United States. They occurred at the rate of about 50 per day. They burned over an average of 21,622,000 acres each year an area larger than the State of Maine. They caused direct damage to timber and property estimated at \$392,000,000. They took scores of human lives.

The great majority of forest fires, especially in the East and South are "ground fires," burning mostly in the duff or leaf-litter on the forest floor. Promptly attacked with adequate manpower and equipment, such fires are fairly easy to control. But nearly every small forest fire is potentially a big one. If a combination of dry weather and high winds occurs, a forest fire may spread with explosive violence, roaring through the trees faster than a man can run, generating waves of heat and gas that fan the flames to even greater fury. A really bad forest fire is a terrifying thing. It will destroy everything in its path.

That was what happened when the Peshtigo fire in Wisconsin in 1871 wiped out whole settlements and killed 1,500 persons; when the great Idaho fires of 1910 wiped out several million acres of virgin timber in a few days. It happened when the Tillamook fire in Oregon in 1933 killed as much timber as the entire United States lumber cut of the preceding year. It happened in Maine in 1947 when forest fires destroyed more than 800 homes. Large, destructive fires occurred in the Western States in 1951. It can happen again. Given the right combination of weather and fuels, big and destructive forest fires are still possible in many parts of the United States.

Losses of merchantable timber and property are direct, tangible and readily apparent. Forest fires, however, cause many damage not so easily recognized. Fire may kill the tiny young trees in a forest and so destroy the mature timber crop of 20, 50, or 100 years hence. Fire may alter the character of a forest. As a result of fire for example, a forest in which valuable pines or spruces predominated may in time become mostly a scrubby growth of inferior species. Repeated fires have made many millions of acres of forest land in the United States into unproductive wasteland.

Even a small, smoldering surface fire may leave fire scars on the trunks of trees, where wood rots may enter. Fire-weakened trees may be attacked by insects, or more easily thrown by the wind. A woodland owner thus may suffer losses in his cash-crop trees, even though the fire actually kills very few of them.

Fires destroy valuable forage on western ranges. When range land burns, ranchers often are forced to find other feed for their livestock for many months. And exposure of the soil when grass and brush is burned may cause erosion and floods.

Storm runoff is greatly accelerated when fires burn the vegetation on steep slopes. A flood that caused \$347,000 worth of damage in Salt Lake City in 1945 came directly from a 600-acre burned area on the grass-and-brush-covered hills north of the city. The Montrose, Calif. flood of 1934, that caused \$5,000,000 damage and took 34 lives, came from a watershed area that had been burned about a month earlier. Following the big Columbia River flood of 1948, watershed technicians

found ample evidence that much water would have been held back until after the flood peaks had passed and damage would have been far less if millions of acres in the upland watersheds had not been depleted of their plant and forest cover, mainly by forest fires.

Fires have impaired the ability of watersheds in many parts of the United States to absorb rainfall and hold back runoff. Along with unwise land-clearing, destructive logging, overgrazing, and other watershed abuses, fire is responsible for a vast amount of flood damage, for aggravated problems of water supply, and for the silting of reservoirs, stream channels, and harbors with millions of tons of sediment eroded from the land.

Forest fires kill many game animals and birds. Wood ashes washed into streams after a fire sometimes kill large numbers of fish. Destruction of the vegetation along stream banks may cause water temperatures to rise and make the stream unfit for trout. Sedimentation from fire-damaged watersheds has ruined many good fishing streams.

Forest fires can hurt tourist and recreation business. Vacationers are not likely to flock to areas where forest fires are reported to be burning, nor to spots where the scenery has been blackened by flames.

Many railroad lines, highways, and telephone and telegraph lines pass through forest areas, and fires can therefore disrupt business communications and railroad and truck transportation.

Losses such as these, and many other indirect and intangible losses caused by forest fires are not easily measured in terms of dollars. But in the aggregate they represent a huge drain on the resources and manpower of the Nation. To the losses caused by fires must be added the costs of controlling them, to keep the damages from amounting to an even greater total.

A Complex Problem

In few parts of the world is the problem of keeping the forests from burning as complex and difficult as it is in the United States. In this country there are regional variations in the seasons of greatest fire danger. The normal fire seasons in the forests of the eastern and central States are spring and fall. In early spring, soon after the snows have melted and before the deciduous trees have leaved out, a few days of sun and wind can dry out the forest litter and create a high fire hazard. After the leaves fall from the trees in autumn, the forest floor is again exposed to sun and wind, and the dry, new-fallen leaves are added fuel. The fire season may extend through the winter months in the deep South. Throughout the Western States, the dry summer months are normally the period of forest-fire danger.

Changes in fuels, weather, or degree of exposure to sources of fire can alter the situation locally or regionally. Prolonged droughts may bring periods of danger during the summer months in portions of the East, or delayed snows may mean that the fire season extends into the winter. A few years ago, foresters had to fight a brush fire in northern California when there was several inches of snow on the ground.

Even within a normal fire season, forest-fire danger fluctuates widely. A fire-control organization must be geared to meet a threat which today may be half what it was yesterday, but which may jump to a hundred times that of today by next week. New activities in

an area may alter the fire problem. Changes in the character of a forest or range—in species of plants, in growth or decay—have their effects.

The forest-fire hazard has increased in recent years throughout much of the West. Epidemic attacks by insects have killed timber over large areas in Colorado, Montana, Idaho, and Wyoming. The bug-killed timber is in many places a tangled mass of fallen trees, where fires can burn hot and spread fast. Heavy accumulations of logging slash intensify fire-control problems in many western forests. And increased industrial and recreational use of the forests means greater numbers of people in and near the forests who might start fires.

Causes of Forest Fires

Most forest fires are caused by human carelessness, negligence, or ignorance. Forest-fire prevention, therefore, is mainly a problem of improving people's ways, of creating a better understanding of the importance of forests and a sense of personal responsibility on the part of every citizen to safeguard the forests from damage. That is not an easy job. A city dweller used to paved streets, for example, does not easily change his smoking habits when he goes into the woods.

During the 5-year period from 1946 to 1950, the causes of fires reported on protected forest and watershed lands of the United States were as follows:

<i>Cause</i>	<i>Percent</i>
Incendiary -----	31
Smokers -----	21
Debris burning -----	17
Lightning -----	8
Railroads -----	5
Campers -----	4
Lumbering -----	2
Miscellaneous or unknown -----	12

Incendiarism, the leading cause of forest fires, is mainly a problem in the South. Of the 40,122 forest fires of incendiary origin reported in 1950 on protected lands, 36,566 were in the Southern States. Persons sometimes start forest fires deliberately to spite a neighbor, to obliterate evidence of a misdeed, or because of a grudge against public authorities. Children, and sometimes adults with immature minds, may set fires in the woods for the excitement of it. But comparatively few man-caused forest fires are set maliciously.

Annual woods-burning has long been a tradition in many rural sections of the South. The woods are fired every spring to "green up the grass," to get rid of underbrush, or because of mistaken notions that ticks or boll weevils can be eliminated by woods-burning. Any benefits, real or fancied, from such yearly promiscuous woods-burning are usually more than offset by the damages to timber and watershed values. Ideas and customs of long standing will have to be changed before this kind of woods-firing can be wholly eliminated. The problem is one of education, coupled with better fire laws and stricter law enforcement.

Debris burning causes many fires in farm woodlands. Too frequently, fires started by landowners to burn trash or get rid of brush

or weeds get out of hand and spread to the woods. A number of the States still lack effective laws to foster safe practices in the burning of debris. Burning off weeds from fields or clearing "new ground" by burning, incidentally, frequently destroys much organic matter that might better be plowed into the soil.

Careless smokers were responsible for 18,259 fires on protected forest lands in 1950. Many of these are started when people toss cigarette butts or matches from automobiles traveling in forested areas. Others are caused by hikers, hunters, fishermen, or woods workers who are careless in disposing of their smoking materials. The Forest Service has imposed rules in many of the national forests that prohibit smoking except at improved campgrounds and other designated safe areas. Many of the States now have laws against throwing lighted materials from automobiles. Smoker-caused forest fires will be wholly eliminated, however, only when millions of smokers have become fire-conscious and have developed the will to improve their smoking habits.

Campers and picnickers who build campfires in unsafe places or who abandon their campfires while still burning are another cause of forest fires. A smoldering campfire left unextinguished can be fanned into flame again if the wind rises, and its sparks may quickly ignite the surrounding woods. Educational efforts to induce campers to douse their campfires thoroughly with water before they leave them, and prosecution of persons responsible for forest fires through negligence with campfires, are reducing the number of fires from this cause.

Railroad operations formerly caused many more forest fires than they have in recent years. Improved spark-arresters and ash pans on locomotives and the conversion to oil burners have reduced the danger from sparks. Many railroad companies now clear their rights-of-way through forest areas and otherwise cooperate with State and Federal forest-protection agencies. The percentage of fires resulting from logging operations also has dropped materially in the past 3 decades. Many timbermen cooperate wholeheartedly; most logging crews observe strict safety precautions; and when bad fires do occur they are usually among the first reserves to be called, and also often the most effective fire fighters. Despite the fact that these industrial fires are relatively few in number, the great damage they frequently do calls for stronger efforts to eliminate them.

Many miscellaneous causes of forest fires have been reported. A few were freak natural causes, such as meteorites, but most of them were the result of human activity.

So, all told, more than 90 percent of all forest fires are man-caused, and therefore preventable. The only important natural and unpreventable cause is lightning, which accounted for about 8 percent of the reported fires on protected lands, Nation-wide, in 1946-50. In the Western States, however, lightning causes a much higher percentage of forest fires than it does in the East. Of a total of 12,393 forest fires in 1950 in the Rocky Mountain and Pacific Coast States, 5,709, or about 46 percent, were lightning-caused.

Summer lightning storms in the western mountain regions often occur with little or no rain. In the northern Rockies and Pacific Coast regions more than 100 fires have been started by a single storm; in the national forests of northern Idaho and western Montana in 1946, Forest Service forces had to fight 1,315 lightning-caused fires in a 2-

month period. Forest fires started by lightning are usually tough to handle; they often occur in rugged, high-country areas difficult to reach and difficult to work in.

Nobody yet knows how to prevent lightning from striking. But advances in knowledge of fire weather are helping forest-protection forces to know when to be on the alert for lightning-caused fires. Adequate and well-equipped forces can control them quickly and hold the damage to a minimum. And recent experiments in "seeding" thunder clouds to cause precipitation have given at least some indication that it might eventually be possible to prevent or control the lightning itself.

Beneficial Uses of Fire

Under certain circumstances, fire can be a useful tool in the forests, if carefully applied and controlled. Research has worked out practicable and safe techniques for using fire to get rid of sagebrush on certain types of western range where topography is not too rough, and thus to aid the natural comeback of desirable grass forage or to prepare the ground for artificial reseeding to grasses. In the southern pine region, controlled burning is being used to aid the regeneration of longleaf pine when heavy growth of broomsedge or other ground cover interferes with natural reseeding. Fire has been found to have a sanitary effect, when properly timed, against the brown spot disease of longleaf pine. Light, controlled burning can sometimes be used to get rid of undesired plants and trees, or to remove heavy accumulations of inflammable ground cover and thus reduce the hazard of destructive wildfire. In the Northwest, broadcast burning at a safe season is often used to get rid of accumulations of logging slash or debris. Such uses of fire, however, should never be attempted except under the direction of experts. Every safeguard must be taken to make sure the fire is confined to the area prescribed for burning.

A great deal more research in this field is needed. But the fact that fire can at times be used beneficially must never be used to condone uncontrolled wildfire in the woods. Because of fire's great potential destructiveness, constant effort to prevent and control wildfire in the forests is a must.

The Status of Protection Today

The forest-fire protection job in the United States involves Federal lands, State- and other publicly-owned lands, and private lands. The Federal Forest Service is directly responsible for the protection of some 180 million acres of national-forest land from fire. This includes federally owned land in national forests in 38 States, Alaska, and Puerto Rico. In addition to the federally owned lands, the Forest Service, under agreements with the States or with individual owners, protects several million acres of intermingled private lands within the exterior boundaries of the national forests. The total area of national-forest land and other land under protection of the Forest Service in 1951 was approximately 209 million acres.

National Forests

In 1950 fires burned over a total of 330,531 acres of national-forest land and other protected lands inside national-forest boundaries (exclusive of Alaska). This was less than two-tenths of 1

percent (0.178 percent) of the area protected. In terms of total protected area it could be called highly effective protection. On a number of national forests, however, the losses far exceeded this overall figure. More than half of the total area burned was in California, where nearly 50 major fires taxed fire-protection forces to the limit. Arizona and New Mexico national forests also had a severe fire season, with an acreage loss 65 percent greater than the 5-year average.

Such heavy losses in individual national forests greatly hamper the orderly long-term management of the forest resources. In some forests, fires over a period of years have materially reduced the total volume of timber, which means that the allowable annual cut under sustained yield is likewise reduced. This cuts down employment and income in adjacent communities. Multiplied many times over in various forest management units, such losses will have an appreciable effect on the Nation's timber supply. On noncommercial forest lands, heavy burning also has far-reaching effects. Because of fires on chaparral-covered watersheds in southern California, for example, millions of dollars have been expended for flood-control works to cope with accelerated storm runoff. Elsewhere, many reservoirs holding irrigation water or municipal water supplies have lost a part of their capacity, and some have been completely filled with debris, because of siltation speeded up by fires on the watersheds.

The success of fire control, therefore, cannot be judged by over-all statistics. It must be judged by the degree to which fire losses are held below the maximum that can be tolerated on each and every individual forest management unit. And it must be judged not only for 1 year but for a long period—the rotation period of a timber crop, for instance, which may be from 25 or 30 to more than 100 years; or the life of a reservoir, which should be as long as it will be needed.

The Forest Service fire-protection forces and facilities in the national forests today can cope with the fires that break out during periods of normal or better than normal weather. But they are spread too thinly to insure against serious losses when unusually bad fire weather occurs. As a matter of sound business, considering the values at stake, the Forest Service should be enabled to build a fire-control organization of sufficient strength to assure adequate protection of those values.

Costs Go Up

Today it costs more than three times as much to employ a fire-fighting crew as it did in 1940. A crew of fire fighters, with the required crew bosses, truck drivers, tractor operators, etc., that cost \$53.65 per hour on the job in 1940, cost \$170 per hour in 1950. This reflects a general increase in the cost of labor during the past decade. In line with this general increase, the base pay rates of fire-control assistants, lookout men, and other personnel who constitute the bulk of the Forest Service fire-protection force, have nearly doubled.

Another element of the increased costs is overtime. It is necessary to maintain 7-day-per-week service in fire protection; services cannot operate on a 40-hour week only, since forest fires can start at any time and can burn just as hot on Sundays as on weekdays. Establishment of the 40-hour week under provision of the Wages and Hours Act in 1945 meant that pay rates would be raised by 60 percent if the same 7-day-per-week service in fire control were to be maintained that had

prevailed more than 40 years. By careful management and by taking some calculated risks, however, the Forest Service has been able to hold overtime costs to about 16 percent of total protection costs.

The cost of equipment and supplies also has increased greatly during the past 10 years. Fire-protection equipment that in 1940 cost \$100 cost \$191.50 in 1950.

All told, today's forest-fire protection dollar has only about 50 percent of the purchasing power it had in 1940. With not enough funds available to make up the difference, the result has been reduced forces to handle an increased fire-protection load in the national forests. The actual total strength of national-forest short-term fire-protection forces in 1951 was 6,046 men, as against 13,074 in 1940 when Civilian Conservation Corps men were used in protection positions, and 9,301 in 1945, after the CCC program ended.

The 1951 Fire Season

To August 31, the Forest Service fought 8,762 fires in the national forests. The area burned was 307,545 acres, compared with an average of 160,812 acres for the corresponding 8-month period of the preceding 5 years.

Of the 8,762 fires in the first 8 months of 1951, all but 114 were brought under control within the first 24 hours after discovery. The great majority were held to a small acreage, but 1,155 got away to reach class C size (10 to 100 acres) or larger. It was these relatively few big fires that accounted for a large part of the total acreage loss. In nearly every case, these run-away fires could have been held to a small area if adequate manpower and quicker transportation facilities had been available.

The Southwest in 1951 experienced the most critical fire weather of its history. Two bad fires in the Gila National Forest and large fires in the Apache, Lincoln, and Crook National Forests early in the summer burned nearly 91,000 acres. High winds swept the blazes into remote areas, difficult to reach.

In the Lake States, danger conditions in June required emergency manning. The Pacific Northwest had the driest spring and summer since 1922. During late August and September a number of fires raged out of control. Logging operations had to be shut down for long periods. California also was suffering from a serious lack of moisture and suffered many bad fires.

Other Federal Lands

Fire is a hazard, in varying degree, on many parts of the nearly 180 million acres of unappropriated and unreserved public domain land of the United States, including the 147 million acres in grazing districts established under the Taylor Grazing Act of 1934. Much of this land is desert or semidesert, or range and watershed land bearing grass or brush, but about 28 million acres is classed as timber or woodland, including some 4 million acres which bears commercial timber stands. The Bureau of Land Management, Department of the Interior, which manages this public domain land, receives appropriations for fire control and maintains a fire-protection organization. Its fire problem is relatively light on large areas of desert and open range, but on some parts of the public domain, the hazard is comparable to that on adjacent national forests.

In Alaska, there are some 290 million acres of unreserved public lands, under jurisdiction of the Bureau of Land Management. By estimate, about 125 million acres of these public lands are forest lands. The Bureau of Land Management has received only nominal appropriations for fire control in Alaska, insufficient to set up organized protection on more than a very small portion of the public lands in the Territory. Nearly every year, fires burn unchecked over large areas in the Alaskan interior. Only about 25 million acres of heavily timbered land has not been burned. Recent sample plot studies in these unburned stands by the Forest Service's Alaska Research Center showed timber stands that compare with those of northern New Hampshire and Maine. They are worth protecting. By the practice of a little silviculture, foresters can probably increase the timber growth substantially—if fire leaves any of the present forests.

Under a 1937 act of Congress, the Bureau of Land Management also administers the Oregon and California Revested Lands, comprising a little over 2 million acres in western Oregon. The O & C lands are intermingled in a checkerboard pattern with national-forest lands and private lands. Under reimbursement agreements with the Bureau of Land Management, the United States Forest Service and the Oregon State forestry department, which have fire organizations already functioning on adjoining lands, handle fire protection on the O & C lands.

The Bureau of Indian Affairs, National Park Service, and Fish and Wildlife Service handle fire protection on lands under their jurisdiction. The armed services provide protection for more than 2 million acres of forest land in Army, Navy, and Air Force reservations. The Tennessee Valley Authority arranges with various agencies for the protection of some 340,000 acres of forest land acquired in connection with its reservoirs.

The Forest Service cooperates with all these agencies. It makes available to them its research findings and newest developments in fire-fighting equipment and techniques. Fire-protection personnel of other agencies are invited to Forest Service training camps and conferences. Fire Control Notes, a quarterly journal published by the Forest Service's Division of Fire Control, serves all Federal, State, and private forest-protection agencies as a clearing house for information on fire-control methods and equipment.

The Forest Service in turn receives excellent cooperation from many agencies. During emergencies in 1950 and 1951, the Army and Navy furnished men and equipment to help fight a number of bad fires. The Coast Guard aided in aerial detection and scouting in California. In Alaska the Bureau of Land Management furnished men and equipment and the Fish and Wildlife Service provided aircraft to help control fires in the Chugach National Forest. The Bureau of Indian Affairs and the National Park Service cooperated in fighting several California and Southwest fires. State forestry agencies gave excellent cooperation in the joint handling of many large fires. The Weather Bureau cooperated in a special spot-forecasting experiment in the Pacific Northwest. The American Red Cross did outstanding work in many fires.

There were many examples of fine cooperation from lumber, pulp and paper companies, and other forest-products industries, and from

local communities and groups. Cattle-grazing permittees organized for fire duty on the Sequoia National Forest. Nearly every able person in the town of Mount Shasta, Calif., turned out to help during a fire emergency in the Shasta National Forest.

State and Private Forest Lands

Under the Clarke-McNary Act of 1924, the Forest Service cooperates with 43 States and the Territory of Hawaii in providing fire protection to State and private forest lands. Cooperative protection under the act now covers 360,564,000 acres. The total area of State and private forest and watershed land needing protection is 426,694,000 acres, so 66,130,000 acres still remain without organized protection from fire.

On those lands under systematic protection, the area burned in 1950 amounted to less than 1 percent (0.95%) of the area protected. Of the lands still lacking protection, 17.7 percent burned over.

Direct damages to timber and property reported on the 360 million acres of protected forest land were about \$14,000,000. On the 66 million acres still unprotected, tangible damages were estimated at \$26,000,000. These damages, it should be emphasized again, do not include such indirect and intangible losses as those resulting from decay of fire-damaged timber, replacement of desirable tree species by less valuable ones, soil deterioration and erosion, uncertain stream flow, destruction of game, reduced tourist travel, interruption of business.

Generally the State forestry agencies and the United States Forest Service organize protection along similar lines and use the same types of equipment and fire-fighting techniques. State agencies have increased the effectiveness of their protection markedly in recent years. Even though the area under protection has been expanded, the total area of protected land burned averaged less in the last 5 years than in any earlier 5-year period of record.

In many areas, however, protection forces are far too thinly scattered, and present facilities are inadequate even to meet the hazards of a normal season, let alone cope with the "blow-up" conditions of abnormal years. State forestry agencies are also up against higher wage rates and increased costs of equipment. Their costs of fire protection also have gone up.

Fire law enforcement has been given increased attention by the States during the past few years. A total of 7,304 cases were prosecuted in 1950—the largest number of prosecutions in a single year to date. Convictions were obtained in 92 percent of the prosecutions. Rather startling, however, is that in 1950 the number of forest fires of incendiary origin on State and private forest lands jumped 51 percent over the preceding year. This occurred mostly in the South. It showed a need for further intensification of forest-fire law enforcement, as well as increased effort in prevention education.

The cost of providing basic protection for the 426,694,000 acres of State and private forest land needing it was estimated last year at \$48,250,000. Funds available for the protection of 360 million acres of State and private forest land in calendar year 1950 totaled \$30,270,587. State and private agencies provided a net of \$21,140,832; the Federal contribution was \$9,129,755, not including administrative costs. Although the Clarke-McNary Act contemplated that the Federal Government would meet half of the total cost of protec-

tion, the Federal contribution has never matched State and private funds. In 1950, State and private expenditures were 70 percent of the total.

Congress in 1949 authorized increased appropriations for Federal participation in the cooperative forest fire protection program. Increases of \$2,000,000 each year to a maximum of \$20,000,000 for fiscal year 1956 and each year thereafter were authorized. Under this authorization, \$13,000,000 would have been available for fiscal year 1951. The actual appropriation was \$9,500,000.

Advances in Fire-Fighting Methods and Equipment

Use of aircraft has been a big help in implementing a "hit-'em-fast-and-hard" policy of forest-fire suppression. With the cooperation of the Army Air Force, the Forest Service experimented with the use of airplanes for fire detection as early as 1919. By 1930, airplanes were being used by the Forest Service in varying degrees in national forests throughout the West and in the Lake States, and also by several of the State forestry departments. Their principal use at this time was for reconnaissance of going fires and for detection of fires immediately after lightning storms.

Emergency transportation of supplies has become one of the major roles of aircraft in fire control in recent years. During the 1930's the Forest Service developed successful techniques for delivering supplies by parachute to fire crews in remote areas. A simple, low-cost, home-made parachute was designed. A total of 174 tons of cargo was parachuted to Forest Service fire crews in 1950. An additional 204 tons of air freight was delivered field-to-field.

Smokejumpers

At the time it developed successful cargo-dropping techniques, the Forest Service also began thinking about the possibility of parachuting men to fires in inaccessible country. Experiments in actual jumping were conducted in 1939. The tests proved that men could safely land in rough, forested terrain. Using techniques developed through these tests, the Forest Service in 1940 trained 16 fire fighters who volunteered for parachute jumping. Additional experimental work was planned, but before the season was over, the men were actually making jumps to fires in inaccessible territory and promptly controlling them.

The "smokejumpers" wore specially designed helmets, masks, and protective clothing. Each carried a rope to let himself down if his parachute lodged in a tree. A special type of parachute was developed, designed for slow descent with minimum oscillation, and equipped with steering slots that enabled a jumper to land within a few yards of his goal. After a man jumped, his fire-fighting pack, containing tools, rations, water canteen, first-aid kit, etc., was parachuted to him. Military staff officers visited the smokejumper training camp in 1940, and many of the Forest Service ideas and techniques were later employed in organizing the first Army paratroop training at Fort Benning, Ga.

Since 1940, smokejumper operations have been conducted by the Forest Service every year in certain sections of the West. The men

are carefully selected and thoroughly trained before the beginning of each fire season. By the use of smokejumper crews, fires in remote areas can be attacked soon after discovery, whereas ground crews would require many hours to reach them. Hundreds of fires have been quickly controlled by the parachuting fire fighters, whereas otherwise they would have spread to large size and caused great damage.

Last year, the Forest Service smokejumper corps numbered 251 men. Crews were assigned to the national forests of Montana, Idaho, and Oregon. A small crew also was assigned to New Mexico early in the season. Crews jumped to a total of 158 fires for initial attack or follow-up. The estimated net savings in suppression costs resulting from the use of smokejumpers was \$257,000. In the first 10 years of smokejumper operations (1940-49) the men jumped to a total of 1,424 fires. Estimated savings amounted to more than \$2,000,000.

The Forest Service has worked continually on the improvement of existing equipment and the development of new equipment to increase the efficiency and safety of aerial fire control operations. Parachutes and parachute packing methods used for dropping fire-fighting equipment and supplies have been improved to reduce opening and landing shock, reduce oscillation, and prevent parachutes and cargo from damaging or catching on the tail surfaces of aircraft. A special parachute-cargo carrier and discharging device has now been developed to permit safe parachuting of supplies from light airplanes manned only with a pilot. This will make possible a reduction in the cost of servicing isolated small fire-fighting crews and lookout stations. Steerable parachutes used by smokejumpers have been improved to increase their forward speed. This permits landing under more adverse wind conditions.

Helicopters

In 1945, the Army and the Forest Service joined in a series of tests with helicopters under western forest conditions. These and the tests of commercial helicopters that followed proved the value of this type of aircraft in forest-fire control work. With its ability to maneuver, fly at slow speeds, and hover, it can enable observers to note the behavior of a fire and the type of ground cover in detail, and so rapidly make accurate organizational plans to combat the fire. Helicopters can be used to transport key men to a fire quickly, to deliver men to fires in isolated areas or directly to the weak sectors of a dangerous fire; also to return men from fires, thus making them more quickly available for other duties.

In 1950, use of helicopters when available was adopted as part of the regular operational procedure. Contract arrangements were made for the use of currently available helicopters when and as needed. The high cost and the relatively small payload of the helicopter are present limiting factors in their use. Many outstanding new developments in this type of aircraft are in progress, and when these become available for civilian use, further experiments will be conducted to determine the limits of safe operation of helicopters and their best application in forest-fire control.

Mechanized Equipment

Ground work in fire suppression is becoming increasingly mechanized. The Forest Service and State forestry departments are con-

stantly working to improve their equipment and develop new items that will increase the speed and effectiveness of fire control. Regional fire-equipment development committees representing State and Federal agencies help to reduce duplication of effort in testing and experiments. Equipment boards within the Forest Service also aid in coordinating effort.

Among recent developments by the Forest Service is a combination tool box and pumper-tanker for $\frac{1}{2}$ - to 1-ton pickup trucks. These combination units serve during the fire season for fire-suppression work, and in off-season, with pumper and hose reel removed, they can be used as a tool and supply box for other work. Much progress also has been made in standardizing forest-fire tanker equipment.

Performance testing of tractor-drawn, fire-line plows is screening the hundreds of different plow designs, proving the best, and aiding in standardization. As a result of the tests, manufacturers are showing increased interest in producing this specialized equipment.

About two-thirds of the cost of forest-fire suppression is for labor; many man-hours of hard, sweating work with hand tools are necessary on most fires because much fire line, especially in rough country, cannot be worked with tractor-dozers or other heavy mechanical equipment. Hence great need exists for small-sized power tools for fire fighters. In the same way that gasoline-powered chain saws have reduced the labor required for tree-felling, small fire-line trenching machines and brush and sapling cutters can aid in fire suppression. The Forest Service has made progress in developing a suitable motor fire-line trencher, and this machine is scheduled to be placed in field service in 1952. Commercial manufacturers are cooperating with the Forest Service in the development of gasoline-engine-powered brush and sapling cutters for forest-fire suppression work.

The Forest Service has special camp equipment for feeding, "sleeping," and caring for fire fighters. During a fire emergency, temporary camps must be set up quickly for dozens, and sometimes hundreds or thousands, of men. Compact camp cooking and other outfits designed for 10-man, 25-man, etc., camps, are kept ready-packed to go out on a moment's notice. The fire-camp equipment is constantly being modernized and made more efficient. Disposable paper and plastic dishes and utensils are now replacing tinware. Camp kitchen crews and equipment needs are being reduced through use of pre-cooked or frozen foods, or delivery (sometimes by air) of ready-to-eat hot meals. Disposable paper sleeping bags, developed in cooperation with the paper industry, save a large part of the costs of cleaning blankets and kapok sleeping bags. Combination unit-packaging of food and mess equipment and its delivery to the fire line by parachute or helicopter reduces the time consumed by fire fighters traveling between fire line and camp.

Communications

Speedy and reliable communications are one of the keys to successful forest-fire suppression. Both telephone and radio systems have a part in the communications networks on the national forests. Primary fire-detection stations are usually connected with headquarters stations by telephone lines. Portable, mobile, and field radios are used by "smokechasers," and for quickly setting up communications on going fires. As commercial telephone and power lines extend farther out

into the forest areas, the Forest Service is constantly altering and modifying its communication systems on the national forests. More radio stations and portable field radios are being acquired each year, in the process of gradually building up the radio communications system to its planned level.

Last year the development of a full line of equipment types for use in a higher radio-frequency band was completed, and more channels will now be available for forestry communications. It will probably take five additional years to replace all the old prewar radio systems and complete the new networks needed in fire-protection areas that still lack radio communication.

Several State forestry agencies also have long been active in developing radio communication networks, and during the past few years the use of mobile and portable radio by other States has rapidly increased. The Forest Service, through its radio laboratory and regional communications officers, is continuing to provide assistance to the States in planning their communications programs. Also, special equipment is being installed in several States for intertying State and Federal forest radio networks, to provide for interchanging fire-control information.

Forest-Fire Research

From the start, progress in all phases of fire control has depended on advances in understanding the behavior of fire in the many varied situations throughout the country, and on discovering new and better ways to keep fires from starting and to fight them skillfully when they do start. Systematic fire control has been built on the results of fundamental and applied research and equipment development over the years. Studies on problems in fire control were among the earliest research projects undertaken by the forest experiment stations. From the earliest days of the Forest Service, too, nearly every man engaged in fire-control work has studied fires and tried new methods, because the problems were challenging, and because administrators have taken the lead in solving them. Consequently, a constant flow of new ideas and rapid development of new and more efficient methods comes from both research and administrative men. Much of their earlier work, however, was by trial-and-error methods, and there was need for more correlation and systematization of research and equipment development activities.

Forest Service activities looking to the development of new or improved fire-control equipment are now directed mainly by the Service's Division of Fire Control which maintains two equipment-development centers, assigns equipment-development projects to engineers and other technicians in the various national-forest regions, works with various manufacturers, and serves as a clearing house for the interchange of information on equipment matters among fire-control agencies. Many of the equipment-development projects are conducted in cooperation with State forestry agencies.

In addition to this on-the-job development work the Forest Service conducts a program of scientific study, through the regional forest experiment stations, on the more basic problems of forest-fire control. To better correlate the fire-research activities under way and to develop a more effective program of research for the future, the Forest Service set up a new Division of Fire Research in 1949. Under the direction

of this Division, studies are under way on the behavior of fires, on improved methods for measuring fire danger, on the visibility factors that affect fire detection both from the air and from the ground, and on numerous other problems that concern the fire administrators and fire fighters on the job. Certain beneficial uses of fire in the forests are being explored. There is a modest program of more fundamental research also, which is concerned with the study of fire itself.

Fire-research activities during the past year included further laboratory and field studies of the advantages and limitations of wetting agents in forest-fire fighting. Three regular fire-fighting crews were equipped with facilities for using both plain water and wetting-agent solutions for comparative trials throughout the 1951 fire season.

New evidence was developed during the year on the relation of local turbulence of the atmosphere to the rate of burning and direction of spread of forest fires. This may point the way eventually to methods of recognizing "blow-up" conditions in advance, which would make possible more skillful fire-fighting strategy. It could save many forest-fire fighters' lives.

The Forest Service in 1951 published a training manual entitled "Water versus Fire," which was prepared by the Service's fire specialists in California. This publication brought together the "know-how" of experienced fire-control officers, pump mechanics, and fire-research specialists in a nontechnical form for effective training of crews in the handling of pumps, hose, and related equipment. The manual is being widely used by Federal, State, and private forest-protection agencies. It also met an immediate need in civilian defense; the Federal Civil Defense Administration planned to distribute it to local defense organizations throughout the United States. Demands for the manual have reached a half million copies:

Cooperative Fire Prevention Campaigns

Since 1942, a Nation-wide campaign has been conducted each year to obtain greater public cooperation in the prevention of forest fires. It is now known as the Cooperative Forest Fire Prevention Campaign, officially sponsored by the State Foresters of 43 States and the United States Forest Service. This campaign has continued each year with the active support of the advertising industry, through its Advertising Council, Inc., and the cooperation of many other organizations and individuals. The Post Office Department and other Federal agencies have helped greatly in displaying fire-prevention posters to the public. The American Red Cross, Boy Scouts, Girl Scouts, and thousands of school teachers are strong supporters. Last year, American business, through the Advertising Council, contributed between 5 and 6 million dollars in free advertising space, time, and talent. This represented the support of advertisers, agencies, newspapers, radio, television, and transportation advertising.

A 1945 campaign poster showed a bear dousing a campfire with a bucket of water. "Smokey," as the bear was called, seemed to catch the public fancy, and since 1947 each year's campaign poster has featured the fire-prevention bear. In 1950, a bear cub, rescued from a forest fire in New Mexico, was named after the fire prevention posters' Smokey, and his story was carried in newspapers and on radio and television from coast to coast.

Localized campaigns conducted by various groups, and the extensive and growing fire-prevention efforts carried on directly by State forestry agencies supplement the Nation-wide campaign. "Keep Green" programs sponsored by the forest-products industries have been organized in nearly 30 States, and provide for educational and publicity efforts on a State-wide basis.

Certainly as a result of these educational efforts, the American public has seen and heard more about forest-fire prevention than ever before. Just how many fires have been prevented by these campaigns is impossible to determine. Undoubtedly, however, they were responsible in no small measure for the fact that the number of fires averaged over 15,000 a year less during the 5-year period 1946-50 than in the years before World War II. This reduction has occurred in spite of increases in registrations in national forests and parks, in sale of hunting and fishing licenses, in motor travel, and in other factors which indicate that public use of forests and outdoor areas was some 40 percent greater than it was 10 years ago.

Fire Protection in Civil Defense

At the request of the Federal Civil Defense Administration, the Forest Service and cooperating agencies early in 1951 began the preparation and assembly of comprehensive plans for protection of all the Nation's forest and wild lands from fire, including possible fire attacks through enemy action. The Department of the Interior and the State Foresters cooperated in the preparation of the operational fire plans. These plans, all told, cover more than a billion acres of forest and range land in the United States and Alaska.

A national committee was set up to coordinate the emergency fire-protection program, with C. A. Gustafson, Chief of the Forest Service's Division of Fire Control, as chairman. Other members of the committee are Joseph Kaylor, of Maryland, representing the State Foresters' Association; John F. Shanklin, of the Bureau of Land Management, Department of the Interior; and Howard J. Eberly, representing the Federal-State cooperative forest fire protection program.

The program calls for planning and organization of forest-fire fighting forces to meet extraordinary situations that might arise in the event of a war emergency. Master Wild Land Operational Fire Plans have been developed for 43 States, providing for the quick mobilization of all presently available fire-fighting personnel and equipment when needed, and for the additional personnel, equipment, and facilitating gear that might be required to prevent a fire disaster or calamity from developing.

During World War II, the enemy was well aware of the damage that forest fires could do to our war effort. Early in the war, an alert Forest Service lookout man stopped a forest fire started by an enemy incendiary bomb dropped by an airplane presumably launched from a Japanese submarine off the coast of Oregon. Later, in 1945, the Japanese made a long-distance attack on the forests of the western United States with incendiary balloons. Besides the direct damage forest fires do to timber, watersheds, and property—and to human life—they can disrupt communications and transportation, tie up logging and other industrial operations, and cause a big drain on the time

of workers on the farms and in the factories—time that would be much better spent at productive work, whether during a war emergency or in time of peace.

Forest Fire Losses Can Be Stopped

Significant progress has been made, especially during the past 20 years, in the development of effective fire-control techniques, and in extending organized protection to forest lands. Wherever systematic, organized fire control has been undertaken, a pronounced decrease in forest-fire losses has resulted.

With adequate forces and facilities and the use of modern techniques, forest-fire losses can be reduced to a point where they no longer are a serious hazard to timber-growing enterprises or to watershed values.

FOREST PEST CONTROL

Fire is not the only "natural enemy" of the forests. Nor, in terms of current damage to timber, is it the worst. Insects and diseases that attack forest trees cause a greater loss of merchantable timber in the United States each year than does fire. The story of forest-fire protection in the United States is one of substantial progress. During the past half century we have extended systematic protection to a major portion of our forest lands, and we have accomplished a great reduction in losses wherever such protection has been applied. With insects and diseases no such reduction of losses can be reported. We have made significant advances in knowledge of these pests and in control techniques. But meanwhile the damage caused by forest insects and diseases has increased.

According to forest reappraisal estimates, the average annual drain from fire during the decade 1934-43 was 460 million cubic feet. The estimated timber loss from insects and diseases during the same period was 622 million cubic feet each year.

This estimated loss caused by insects and diseases represented only the more obvious losses, mainly those occurring as a result of epidemic outbreak. It covered only commercial timber volume, and took no account of the growth potential, nor of species value. It did not cover damage to watersheds, nor increased fire danger. And even in the case of commercial timber, the total loss would be vastly greater if it were possible to measure the damage caused by the normal activity of a myriad of insect and wood-destroying pests ever present in the forests.

Many thousands of different kinds of insects, fungi, bacteria, and other pests and parasites affect the forests. Some of these are beneficial, as the insects that aid pollination, or the fungi and bacteria that help reduce dead wood and leaves to humus. But many are destructive; they may deform trees, slow their growth, or cause their death. In epidemic outbreaks, they can demolish vast stands of timber.

A certain degree of natural balance obtains between the trees and their native insects and disease pests. But the so-called balance of nature is never an exact balance at any moment; it is an averaging out over long periods of time. Meanwhile the trees of one or another species may be all but wiped out over a wide area by insects or disease, and then may or may not regenerate in that area after the epidemic has run its course. In various parts of the country, evidences can be

found that forest pests in earlier times have run their course in uncontrolled, devastating epidemics.

The natural balance has been affected, too, by the activities of man—by his timber cutting and clearing of land, by his causing woods fires, by his transplanting of species from one region to another and introduction of exotic species from foreign lands. He has allowed foreign insects and diseases to enter this country too, and some of these, such as the chestnut blight, the Dutch elm disease, the Japanese beetle, and gypsy moth, have become especially virulent and destructive in their new environment.

Insect Enemies of Trees

Insects may affect forest trees at any time during the trees' life cycle. Certain pine cone beetles, for example, at times destroy nearly 100 percent of the seed crop of some of the western pines. When this occurs, practically all tree regeneration of the affected species is prevented. This will affect the character of the timber stand many years later. Other insects, such as white grubs, may cut off the roots of nursery stock and of newly established tree seedlings, and this again will alter the proportion of a particular tree species in a future stand. The pine reproduction weevil and the pales weevil often destroy large numbers of recently planted trees. During the sapling stage of a timber stand, various insects do damage in varying degrees. The white pine weevil, for example, attacks sapling-size white pines in the Northeast, especially in plantations and in young stands seeded in old fields or clearings. This weevil's attacks in the sapling stage causes crooked growth, and so may greatly reduce the final value of the mature timber stand. Some insects, such as the bark beetles, generally attack mature trees or overmature trees weakened by old age. Others, such as the spruce budworm, attack trees of all ages. Bark beetles and spruce budworms are among the worst killers of trees.

The insect enemies of trees also have their own natural enemies. Birds consume large numbers of insects and help to hold them in check. Frequently local outbreaks of bark beetles are completely checked by woodpeckers. Moles, shrews, chipmunks, and other small mammals likewise have an important role in the destruction of forest insects, especially those hibernating or spending their grub stage in the soil. Insects are subject to diseases caused by bacteria, fungi, viruses, and other organisms. And there are many beneficial insects that prey upon the harmful species. The beneficial insects include parasitic wasps and flies which deposit their eggs on or in the body of another insect and whose larvae feed on the body of the host. Other insects, such as lacewing flies, the praying mantis, and certain kinds of beetles and ants, are predators that devour large numbers of forest insects.

Extreme changes of winter temperature in a short time may wipe out vast numbers of insects. On the other hand, extended droughts may make trees more readily susceptible to attack, or windfalls may create conditions favorable for insect population increases. Trees weakened by fire are especially attractive to certain insects, and forest fires are sometimes followed by insect outbreaks. Conversely, the dead trees left after an insect epidemic may make a greatly increased fire hazard. A fire in a tangled mass of fallen dead trees burns fiercely

and is almost impossible to stop. Even the snags of occasional insect-killed trees scattered through a green forest add greatly to the difficulty of fire control.

Normally, climatic changes, natural enemies, and other factors tend to hold the populations of most injurious insects more or less in check. The aggregate damage caused by these injurious insects is enormous, but the annual growth in the forest as a whole is sufficient to offset it, or to produce a net accretion of timber.

Under certain conditions, however, some kinds of injurious insects may build up in excessive numbers. A particular species may, during one period, be very rare. Yet within a short time it will be found by the millions within a small area.

When such epidemic infestations of destructive forest insects occur or are threatened, immediate and drastic control measures are necessary if huge losses are to be avoided.

Bark Beetles

Old-time foresters used to chant a bit of verse about "the bug called *Dendroctonus*" who lived in the bark of the pine, and was harder to kill than a lion. This referred, in imperfect rhyme but with much feeling, to the bark beetles of the genus *Dendroctonus*. Bark beetles are among the most destructive forest insects from the standpoint of commercial timber values affected. The larvae of these beetles feed under the bark of a tree, next to the wood. In sufficient numbers, they can kill the tree in a single season. The bark beetles are represented by a number of species. They generally attack the large, mature trees—trees that contain merchantable timber.

It is characteristic of bark-beetle infestations that they can quickly flare up into devastating epidemics. An epidemic of the Black Hills beetle (*Dendroctonus ponderosae* Hopk.), that ran from 1895 to 1908, killed practically all the mature pine on more than 100,000 acres in the Black Hills of South Dakota. The same species of bark beetle, in a rapidly spreading infestation in northern Arizona from 1917 to 1926 killed an estimated 12 percent of the entire stand on the Kaibab Plateau. In Idaho and Montana, foresters still have to cope with a greatly increased fire hazard caused by the ravages of bark beetles in lodgepole pine stands over millions of acres in the early 1920's. In recent epidemics in the Western States, bark beetles are estimated to have killed some 45 billion board feet of pine timber.

It is this type of insect, specifically the Engelmann spruce bark beetle (*Dendroctonus engelmanni* Hopk.), that is currently causing great damage to timber stands in western Colorado, and is threatening all the Engelmann spruce stands in that State and the adjoining portions of neighboring States. In the past 10 years, these insects have killed more than 4 billion board feet of timber, an amount equal to the lumber for 400,000 five-room houses. They have killed 16 times more timber than was destroyed by fire in the past 30 years in the entire Rocky Mountain region. They left gray ghost forests of dead trees over wide areas.

New, effective control methods, recently developed by the Bureau of Entomology and Plant Quarantine, have made feasible a control program to prevent the spread of this vast infestation to other areas of green timber. Control operations against the Engelmann spruce

beetle were started by the Forest Service on the White River, Routt, and Arapaho National Forests in June 1950, with emergency funds made available by Congress. Spraying continued through the summer until fall snows closed the work camps. More than 784,000 individual trees were treated. In 1951, the Forest Service was unable to resume control operations until late in the year when a regular appropriation for the work became available.

Very great values in watershed protection and in scenic and recreational resources are threatened by the beetle epidemic in Colorado. The destructive infestation can be controlled. To fail to do so would invite losses and damage that would be permanently detrimental to the welfare of a large region.

The most destructive bark beetle in the East is the southern pine beetle (*Dendroctonus frontalis* Zimm.). It attacks nearly all species of pine from Pennsylvania south to the Gulf of Mexico and west to the Ozarks. Rather frequent local outbreaks of this insect throughout the South have killed large quantities of timber.

Defoliators

The defoliators, as an insect group, rank with the bark beetles as destroyers. They include such destructive insects as the tussock moth, larch sawfly, spruce budworm, tent caterpillar, and the imported gypsy moth and Japanese beetle. These weaken or kill trees by eating their foliage. Generally trees of all ages are affected.

Prevalent over extensive acreages in the Pacific Northwest is the spruce budworm (*Choristoneura fumiferana* Clem.), which is defoliating Douglas-fir and white fir, and causing much loss of tree growth and the death of many trees. Positive control of this insect is being accomplished, however, in a cooperative program that so far has covered well over a million acres.

The spruce budworm also is a destructive pest in the Northeast. In an epidemic lasting from about 1910 to 1920 that ravaged the spruce and fir forests of northern New England, eastern Canada, and Minnesota, it was estimated that the equivalent of more than 25 years' supply of pulpwood for current annual American paper requirements was lost. Epidemic outbreaks of the spruce budworm have again occurred over large areas in Canada in recent years, and smaller outbreaks took place in New England and the Adirondack region of New York.

Borers and Other Bugs

The many kinds of "bugs" that attack forest trees include aphids and scales that suck the juices from foliage or twigs and thus weaken trees and slow their growth. Other insects lay eggs in the flowers, fruit, or seeds of trees. When the larvae hatch, the damage caused by their feeding may prevent the tree from producing seed. Certain flies, moths, beetles, and wasps cause the growth of galls when they deposit their eggs in the living tissues of the stems, leaves, or fruits of trees. The familiar "oak apple" is an example of an insect-caused gall.

Woodborers and other insects often cause injuries to living trees which show up as defects in the lumber and thus reduce its value. Woodborers and termites also cause great damage to felled timber, lumber, poles, posts, and wood in buildings. The grade of lumber cut from logs may be lowered by the borings of worm-hole or pin-hole

borers in the green logs. Nearly everyone is familiar with the work of powder-post beetles in furniture, floors, and tool handles. Tremendous damage to building foundations, fence posts, telephone poles, and wood in many other uses is caused by various species of termites.

Control Methods Improve

Revolutionary improvements in forest insect control techniques have occurred during the past 10 years. This has come about not only through the discovery of potent new insecticides but also through development of better facilities for applying these insecticides.

Not long ago, the only method for controlling bark beetles was to fell every infested tree, strip the bark from it and burn it. Now beetle infestation can be controlled in most stands by treating the standing trees with an insecticide. Orthodichlorobenzene, mixed with fuel oil, is used. The insecticide penetrates the bark to inner recesses and its fumigating effect kills the beetle larvae. This method was used successfully in bringing under control a recent epidemic of mountain pine beetle in lodgepole pine in the Targhee and Teton National Forests of Idaho and Wyoming. It was successful, too, in controlling a 1949-50 outbreak of Black Hills beetle in the Harney and Black Hills National Forests in South Dakota.

Another new insecticide, ethylene dibromide, is being tested against bark beetles. It has advantages over orthodichlorobenzene: It is less bulky to handle, and water can be used as the diluent instead of oil. Tests in the use of this material for a variety of species and under a variety of conditions are being continued under direction of the Bureau of Entomology and Plant Quarantine.

Aerial spraying is ineffective against bark beetles because the mist sprays from the air will not reach the beetle larvae under the bark of the trees. Bark beetles therefore must be attacked with forceful sprays from the ground, and treatment so far is still on a tree-by-tree basis.

Airplane spraying is feasible, however, against defoliators such as the spruce budworm and the Great Basin tent caterpillar. These can now be controlled through the use of DDT dissolved in hydrocarbons (fuel oil and such). At the strength used ($\frac{1}{2}$ to 1 pound per acre) the DDT apparently causes no serious damage to birds and mammals in the forest.

The first large-scale use of airplanes for DDT spraying over a western forested mountain area was in a 1947 operation against the tussock moth in northern Idaho. This was the most violent outbreak of Douglas-fir tussock moth (*Heemerocampa pseudotsugata* McD.) ever discovered. It threatened millions of dollars worth of grand fir and Douglas-fir timber. The epidemic was completely controlled by an airplane spraying project covering 413,500 acres and involving 2,120 individual flights to distribute 391,000 gallons of insecticide. The Bureau of Entomology and Plant Quarantine, Forest Service, State of Idaho, and private landowners cooperated in the project.

Aerial application of insecticide is also successfully controlling infestations of the spruce budworm in Oregon and Washington. Some 250,000 acres of Douglas-fir forest in western Oregon were sprayed in 1949. Another huge aerial spraying job, covering some 966,000 acres in 1950 and 940,000 acres in 1951, was conducted in eastern Oregon and Washington.

In 1949 the Massachusetts Department of Conservation directed a project for the aerial spraying of 229,000 acres of woodlands on Cape Cod to control the gypsy moth. The Federal Government, State, county, and towns cooperated in the enterprise.

Work at the Forest Products Laboratory and by State and private agencies has developed chemical treatments and improved drying, storage, and construction practices that make possible the prevention of much damage to wood from wood borers and termites, and from stain and decay. Continued research will produce even better and more economical methods to protect wood from such pests, and thus help to extend our national timber supply, and further increase the utility of wood.

Beneficial Effects of Silviculture

Good forest management will help to prevent the build-up of many kinds of injurious insect pests. Vigorous rapid-growing trees are apt to be less susceptible to attack by bark beetles and defoliators than slow-growing mature trees or trees weakened by crowding or other unfavorable growing conditions. Removal of overmature timber, thinning young stands to maintain rapid growth, and disposal of logging slash which may be a breeding ground for some insects, are measures that help to prevent conditions favorable to the increase of insect populations.

Special silvicultural practices that aid insect control are being worked out through research. The Northeastern Forest Experiment Station and the New Haven Station of BEPQ have made studies looking toward improving methods of cutting in northern coniferous forests as a means of controlling spruce budworm. Overmature and decadent balsam fir is especially vulnerable to attacks by this insect. Removal of these trees from spruce-fir stands not only reduces the likelihood of severe attack but promotes more vigorous growth of the younger, better trees in the forest.

F. P. Keen, of the Bureau of Entomology and Plant Quarantine, working in cooperation with the California Forest and Range Experiment Station, has conducted studies which recognize the beneficial results that accrue through silvicultural practices. Logging which usually removes the old and stagnant trees tends to prevent a build-up of the ponderosa pine beetle (*Dendroctonus brevicornis* Lec.) to the degree that fosters epidemics. Harvesting of ponderosa pine timber from the national forests where this insect is prevalent is based on the Keen finding that susceptibility to bark beetle attack is directly related to the health of the tree as indicated by the length, color, and density of needles and dying twigs. The Keen studies have provided an index of growth vigor which makes it possible to log selectively the most susceptible trees and thus reduce the danger of beetle infestations.

Diseases of Trees

Like mankind, the trees of the forest are subject to many ills. The diseases that threaten trees frequently are highly contagious. They may be caused by bacteria or fungi, by viruses, or by microscopic nematodes or eel worms. There are parasitic plants, too, such as mistletoes and dodders, that damage trees.

Various fungi and bacteria produce leaf spots, rusts, wilts, and blights that cause defoliation and so weaken trees. Others cause cankers, galls, or root diseases that likewise slow the growth of trees, or kill them. The decay fungi cause deterioration of wood in standing trees in the forest and reduce its value for use as lumber, posts, poles, in buildings, and for other purposes.

Trees weakened by fungi often are more susceptible to attack by insects. And insect-damaged trees, conversely, may be more subject to disease. Most of the virus diseases, and some of the stain and decay fungi, are spread by insects. Fire wounds on trees are entering places for decay fungi.

Under natural conditions the injuries caused by disease, like those caused by insects, are offset in time by new growth, and the forest survives. But the natural balance is achieved only with tremendous losses. These losses for the most part are inconspicuous; they result from the weakening of trees and slowing of growth, and from the deterioration of wood by stains, molds, and decay. It has been estimated that the heart rot fungi alone cause an annual saw-timber loss of 1½ billion board feet in the forests of the United States.

There are some destructive new diseases introduced by man, as well as certain old diseases that have become epidemic as a result of man's activities. These are major threats; they are capable of wiping out whole species of trees. The chestnut blight, a fungus disease brought to this country from Asia around the turn of the century, has practically done so. The American chestnut was once one of the most important commercial forest trees of the eastern United States. In a few decades, the disease destroyed all commercial growth of native chestnut throughout its range. White pine blister rust, another introduced fungus disease, is capable, unless controlled, of killing out the valuable white pines of both the Eastern and Western States. The American elm, more valuable as a shade tree than as a forest tree, is threatened by the Dutch elm disease, brought in from Europe. Phloem necrosis, a virus disease, presumed to be native, also is killing many elm trees in the Midwest. Oak wilt is a major threat to all eastern species of oak.

White Pine Blister Rust

Because of its threat to valuable commercial timber, the white pine blister rust is one of the most serious forest tree diseases in the United States. The blister rust attacks and destroys white, or five-needled, pines. Among the native five-needled pines are three of our leading timber species: The eastern white pine of the Eastern and Lake States; the western white pine which is a leading timber tree of the northern Rocky Mountain region; and the valuable sugar pine of California and Oregon. The timber of these three species, as it stands today in the forests, is worth hundreds of millions of dollars. It is the raw material of numerous mills and manufacturing industries employing thousands of workers and forming the economic basis of many communities.

These three valuable species, along with other five-needle pine species of lesser value, are endangered by a fungus disease brought to this country from Europe. Blister rust was first discovered in New York State in 1906. By 1915 it had spread widely among native

white pines in the Northeast. In 1921 the disease was found in the Pacific Northwest.

The blister rust fungus spends a part of its life cycle on an alternate host—various kinds of currants and gooseberries, plants of the genus *Ribes*. The fungus does not spread directly from pine to pine; it can spread only from ribes plants. Control is possible, therefore, by eradication of ribes in the vicinity of white pines.

Control operations were started by the Department of Agriculture in cooperation with the Northeastern States in 1922. They were extended to the Lake States, the southern Appalachians, and the northern Rocky Mountain and Pacific Coast States as these regions were invaded by the disease. The Bureau of Entomology and Plant Quarantine has been assigned responsibility for general leadership, coordination, and technical direction of the control program, and for control operations on State and private lands. The Forest Service is responsible for control operations on national-forest lands, as are other Federal agencies on lands under their jurisdiction. Control operations on State and private lands are financed jointly with Federal and State funds, supplemented by county, township, and private owner contributions of funds or services. White pine stands in 32 States are being protected against the disease.

Eradication of wild currants and gooseberries from white-pine areas is mainly a job of hand-pulling or grubbing with hand tools. In some locations, chemicals or mechanical equipment can be used to speed up the work of destroying these bushes. Fire protection and forest management that keeps the stands of trees dense and vigorous helps to suppress the growth of wild ribes.

The blister rust control area in the United States totals about 26 million acres of selected lands in which white pine is of such major importance as to make control work economically justifiable. On some 14 million acres, or 55 percent of the area, the disease is now under control, and only a low-cost program of maintenance will be needed to keep this land safe for the production of white pine. Most of this acreage is in the Eastern and Lake States. An additional 9 million acres has received partial protection. Follow-up work, properly timed, will be needed to make this area safe. Almost 3 million acres still need to be worked over for the initial removal of ribes. In some parts of this unworked area most of the pines already are fatally infected. First priority must be given, however, to follow-up work on the 9 million acres partially protected, so that the benefit of this work will not be lost.

Even when control is effected throughout the designated control area, we shall still be surrendering to the disease a vast amount of valuable white pine timber growth in scattered and mixed stands.

Oak Wilt

Oak wilt is a fungus disease that is causing much concern, because of its rapid spread in the Midwestern States during the past few years. In 1951 the disease was found in seven more States—Michigan, Maryland, West Virginia, Virginia, North Carolina, Tennessee, and Kentucky.

The disease attacks all species of oak native to these States, but it develops most rapidly on red and black oaks. The fungus grows in the sapwood of the tree, and many infected trees soon die. The

agent that spreads the disease has not yet been discovered. It is known that local spreading takes place through natural root grafts between neighboring trees, but this does not account for the long jumps indicated by the newly discovered points of infection.

So far, there has been no indication that oak wilt is developing the momentum that characterized the spread of the chestnut blight. It is hoped that research by the Department of Agriculture and State agencies will develop an effective method of control.

Brown Spot and Little Leaf

Longleaf pine in the South is highly susceptible to a disease called brown spot needle blight which is present in varying degrees over the entire southern pine belt. The disease is caused by a fungus which attacks small pine seedlings, retarding their growth. Successive defoliations may eventually kill many of them. Successful regeneration or reforestation of longleaf pine is often seriously hampered by the presence of the disease.

Infections of brown spot can be checked by the use of fire. Carefully controlled burning of infected plantations or areas of natural reproduction is now being practiced to control the disease in grass-stage seedlings. Many acres of young longleaf pine that were treated in time now have healthy, well-stocked stands of sapling trees.

Longleaf pine is one of the most important forest trees of the South. It makes up a large proportion of the total annual lumber cut of southern pine; it furnishes some 40 percent of the naval stores production; and it is well adapted for paper pulp.

Another menace to southern pine timber growing is the little leaf disease. This disease occurs in the Piedmont region from Virginia to Alabama and northern Mississippi. It affects mainly the short-leaf pine, another of the South's important timber trees. Affected trees show shortened and yellowish foliage; the tree's growth is slowed, and after a few years many trees die. The cause of the disease has not yet been determined. It may be a root fungus, a virus, or lack of some element in the soil. Heaviest losses are usually in trees between the ages of 30 and 50 years. Demand for pine for pulpwood makes possible the profitable salvage and marketing of trees of this age when little leaf disease appears.

Pole Blight

In the northern Rocky Mountain Region, foresters have become increasingly alarmed about a recently discovered disease called pole blight, affecting western white pine. The disease was first observed in northern Idaho in the 1930's. It attacks pole-size trees; affected trees die in from 1 to 10 years. The disease already has damaged western white pine stands on thousands of acres. Some small areas already show a 100-percent kill of white pine.

Western white pine of the pole-size age class is scarce in the northern Rockies. If the pole blight should wipe out a large portion of the stands of this age class, continuity of production will be disrupted. The disease would seriously hamper efforts to perpetuate western white pine and the industries and local economies dependent upon it.

The cause of pole blight is unknown. Intensive research is under way to determine what causes this disease and whether or not it can be controlled.

Dwarf Mistletoes

Dwarf mistletoes are serious pests of western coniferous forests. These are parasitic plants, related to the familiar Christmas mistletoes, that grow on the branches and stems of the trees. They slow the growth rate of infested trees and cause much loss from degrade or cull in logs. Infested trees are subject to attack by insects and fungi, and the mistletoe itself kills many trees. Various species of dwarf mistletoe attack most kinds of coniferous trees in the West. One species is found in the Eastern and Lake States, mainly on spruce. The pest does not occur in the pine forests of the Southeast nor in the Douglas-fir region of Oregon and Washington. But it is reported to be the greatest single cause of loss in ponderosa pine in the Southwest.

When the seeds of dwarf mistletoe ripen, the seed casings rupture and the seeds are shot out with explosive force. They may travel as much as 60 feet. The seeds are sticky, and those that strike branches of other trees or other branches of the same tree may adhere and start new plants. Once the parasite is established on a single tree, therefore, it tends to spread slowly but steadily to other trees in the forest.

Mistletoe can be controlled by pruning it out, and this may be a practicable and worth-while measure when infestations are found in their early stages. In managed forests, mistletoed trees can be marked for cutting at the time merchantable trees are being logged, or they can be eliminated in thinning and weeding operations in young stands. Continued research should lead to more effective silvicultural practices for checking the parasite as well as to practicable methods for direct control.

Wind and Weather

Like man again, the trees of the forest may suffer from diseases caused by nutritional deficiencies or excesses—and the trees cannot individually control their diet, as human beings can. Fertilization and other soil-building measures that are used with orchard and shade trees are not ordinarily practicable under forest conditions. As the practice of forestry becomes more intensive, however, certain soil-improvement measures may become feasible. Much more research is needed on the relation of forest soils to tree growth and pest control.

Nonparasitic diseases of forest trees also may be caused by drought or too much water, or by sunscald or winter injury. Smoke and gases from industrial plants sometimes injure or kill trees. Devastating damage was done to trees in the Ducktown basin in southeastern Tennessee, for example, by tree-killing fumes from a copper smelter.

Wind and weather can cause tremendous damage. The great hurricane that swept into New England on September 21, 1938, left wind-thrown timber, in large and small bodies, over some 15,000,000 acres. Fifty-one counties in the six New England States were affected. The greatest timber damage occurred in Massachusetts and New Hampshire. On some 600,000 acres the mature trees were almost completely felled.

The volume of timber blown down was estimated to be 2,650,000,000 board feet. Some 1,600,000,000 board feet was finally salvaged, largely through an emergency timber salvage program administered by the Forest Service, acting as agent for the Federal Surplus Commodities

Corporation and the Disaster Loan Corporation. There was an inestimable amount of damaged young growth which had no immediate salvage value, but which constituted the potential raw material for much future forest industry operation in New England.

In January 1944 a severe ice storm in east Texas caused great damage to the forests. Millions of trees were broken or knocked down by the wind and the weight of the ice that formed on their branches. About 400,000 acres contained stands of timber of sufficient density to justify salvage operations, and another emergency timber salvage program was organized.

In November 1950 a terrific hurricane caused unprecedented devastation on both private and public forest lands in the Adirondack region of New York. About 425,000 acres of forest land suffered wind damage, which in some places meant that 100 percent of the standing timber was down.

Mississippi's forests suffered severely in February 1951, when an ice storm covered some 16 million acres of the State. Wood-using industries, woodland owners, and State and Federal foresters were working to utilize as much of the salvageable timber as possible before it deteriorated too badly.

Wind and weather damage often creates conditions favorable for epidemic buildups of forest insect and disease pests. Windthrown trees from a 1939 windstorm were the breeding ground for the destructive epidemic of Engelmann spruce bark beetles in Colorado. The work of insects and rot fungi usually causes rapid deterioration of windthrown or storm-damaged timber; hence, prompt salvage operations are necessary if the wood is to be saved while it is still usable.

Research is developing ways to minimize windstorm damage to timber stands through forest-management practices. Reducing the danger of windthrow is a consideration, for example, in the strip or patch cutting systems used in mature timber stands in some sections of the Northwest. The residual stands, left in dense blocks or strips, are less subject to windthrow than when scattered trees are left.

The Forest Pest Control Act

Of necessity, the control of forest pests is primarily a public responsibility. It requires large-scale organization and operation, too big for most forest-land owners to handle individually. The job calls for trained specialists in forest entomology and forest pathology and silviculture. The research needed must be continued over long periods and in many parts of the country—the kind of research that individual forest owners are generally not in a position to conduct. Control operations often must be carried on over wide areas without regard to property lines.

When Congress in 1947 passed the Forest Pest Control Act (61 Stat. 117; U. S. C. 594-1 to 594-5) it recognized the Federal concern and responsibility in the control of forest insects and disease on a Nation-wide basis, and on land in all classes of ownership. The act declared it to be the policy "of the Government of the United States independently and through cooperation with the governments of States, Territories, and possessions, and private timber owners to prevent, retard, control, suppress, or eradicate incipient, potential,

or emergency outbreaks of destructive insects and diseases on or threatening all forest lands irrespective of ownerships." The act paves the way for establishment of more adequate services and facilities for prompt detection and suppression of forest pests.

Department Teamwork

The Bureau of Entomology and Plant Quarantine in the Department of Agriculture provides technical leadership in matters of forest insect control. It advises the Forest Service and other Federal forestland managing agencies on insect-control problems. The States and private landowners also may obtain technical information and advice from that bureau.

It is the function of BEPQ to detect outbreaks and identify forest insects, determine the extent of infestations and a measure of their economic potential, and, where appropriate, to advise on or direct control activities. The bureau conducts research on forest insects and their habits, and on development of new insecticides and control methods. BEPQ maintains forest insect specialists at several of the Forest Service's regional Forest and Range Experiment Stations, who work on regional pest problems in cooperation with forestry specialists in other fields.

Research on forest tree diseases is conducted by the Division of Forest Pathology, Bureau of Plant Industry, Soils, and Agricultural Engineering. The division also maintains specialists at most of the Forest and Range Experiment Stations, and provides technical advice and services on tree-disease problems to the Forest Service and other forestry agencies.

Upon being advised by the forest entomologists or pathologists that a forest pest is attaining epidemic proportions on a national forest, and that control operations are biologically feasible, the Forest Service sizes up the values at stake and makes the decision as to whether control expenditures are economically desirable. If control is decided upon and the necessary funds are available, the Forest Service then carries on the control operations, with the entomology or forest pathology specialists acting in a technical advisory capacity. Where extensive State or private holdings are intermingled with national-forest lands, various cooperative arrangements may be made. In the case of the Oregon spruce budworm project, for example, the Federal Government contributes one-fourth, the State three-eighths, and the private landowners the remaining three-eighths of the cost of control operations on private lands.

Control operations wholly on non-Federal lands may be directed by BEPQ, with the States and private owners sharing costs, or the State forestry departments may direct the work under technical guidance of BEPQ. A number of States now have entomologists and forest pathologists attached to their forestry staffs, and several States have laws placing responsibility with the State forestry departments for insect and disease control work on non-Federal lands.

Operations in 1951

During the fiscal year 1951, \$3,729,458 appropriated under the Forest Pest Control Act was expended. Of this amount, \$239,500 was spent for detection and appraisal surveys by the Bureau of Entomology and Plant Quarantine, and \$41,500 was spent by the Bureau of Plant Indus-

try, Soils, and Agricultural Engineering, mainly for work on the oak-wilt disease and on pole blight of western white pine. With the balance, control operations of significant proportions were carried on in 14 States, along with numerous small projects undertaken in various places throughout the country.

The control work handled directly by the Department of Agriculture was done by the Forest Service, primarily on national-forest lands, with BEPQ advice. In some instances the Forest Service also carried on control work on other public lands, as in the Oregon spruce budworm control project, where lands under jurisdiction of the Department of Interior's Bureau of Land Management and the Indian Service were sprayed under direction of the Forest Service in conjunction with the spraying of adjacent national-forest lands.

For the control season ending December 31, 1950, 25 separate pest-control projects were conducted in 45 national forests. A total of 842,319 beetle-infested trees were individually sprayed, and 966,267 acres were broadcast sprayed, mostly by airplane. Among the major projects carried on, in addition to the spruce budworm control project in the Pacific Northwest and the Engelmann spruce beetle project in Colorado, were control operations against pine bark beetle infestations in the California Sierra, in the Kootenai National Forest in Montana, and in the Targhee, Caribou, and Teton National Forests and Grand Teton National Park in Idaho and Wyoming.

White pine blister rust control work was carried on under a separate appropriation on 191,392 acres of national-forest land, 69,490 acres of Indian, National Park, and O & C lands, and 1,128,985 acres of State and private lands during 1950.

An Urgent Need

Most native forest insect and disease pests, and many of the introduced ones, are so well established and so widely distributed that their complete eradication would be practically impossible. Nevertheless, it is possible and feasible to establish a satisfactory degree of control over the more serious pests. It is possible and feasible to eradicate a newly introduced pest that is still confined to a limited area. And it is possible to keep other new pests from entering this country. It is urgent that we apply the necessary measures to keep the losses caused by these pests to the lowest practicable level.

More Research Essential

Basic to an effective pest-control program is knowledge of the pests and how they work. Much valuable research has been done; much more is needed.

Research on forest insects and diseases has been conducted largely by public agencies, most of it by the Department of Agriculture. Some States are conducting research on various pests, through their agricultural experiment stations or forestry schools. Private research efforts in these fields have been chiefly directed toward the development of preservatives and treatments to protect wood in use. Commercial developments in insecticides and herbicides also have been of value in forest control operations.

State and private agencies should continue to do all they can. But it devolves upon the Federal Government to see that the Nation as

a whole has the necessary technical information on which to base control. The Department of Agriculture should continue to work for the effective correlation of Federal, State, and private activities and to serve as a national clearing house for research findings. It should be enabled to expand its program of basic research on timber insects and diseases affecting each important timber type in the United States. More study is needed also on foreign pests. Additional knowledge of dangerous foreign insects and diseases that might get into the United States could help provide practicable means for keeping them out.

Quick Detection and Attack

A well-organized detection system can discover many small outbreaks of forest insects or diseases before they develop into epidemics. Early indications of an incipient epidemic can be recognized by trained technicians. Introduced pests usually develop first in localized areas. Their discovery should not be left to chance, but should be provided for by a permanent, organized detection system. This calls for inspection units of trained forest entomologists and forest pathologists. It calls also for the participation of Federal land-managing agencies, State agencies, and private landowners, with over-all leadership and correlation by the technical bureaus of the Department of Agriculture.

As in forest-fire control, prompt action against forest pests will keep down both the cost of control and the losses. Too often, valuable time has been lost in attacking insect or disease epidemics while organizing for a special project and while waiting for the necessary Federal or State funds to become available.

Obviously, when control of an epidemic is undertaken, it must be carried through to completion. Otherwise the work may be waste effort. And the control program, to be successful, must be applied over all lands involved. Many pests are common to an entire region and epidemics often extend across State boundaries, making cooperation between States, and between States and the Federal Government necessary for efficient control.

The Forest Pest Control Act of 1947 provides the foundation for such a program of detection and control. Fully implemented, it will make possible the prevention of great losses in the forests.

Good Forest Management

In the long run, good forest management, applied Nation-wide, will help greatly in the defense against most insects and diseases. Healthy, vigorous trees in well-managed forests generally are better able to resist attack.

There are exceptions to the rule that young, vigorous trees are more resistant. Blister rust will kill young white pines faster than old ones. Some of the tip moths, sawflies, and twig weevils are more destructive in sapling-size stands. But in general, forestry practices that produce vigorous, fast-growing crops of trees of species well adapted to the site will reduce losses from insects and diseases. As for blister rust and some of the others, special methods of silvicultural management have been devised to aid in their control.

The use of proper forestry methods in harvesting timber from over-mature forests converts these to thrifty, growing forests. The trees

most susceptible to attack by certain bark beetles and by many other insects and diseases are eliminated. Heart-rot fungi generally are most prevalent in old stands, so development of high-grade timber forests on commercial rotations will prevent much of the heavy loss from heart rots.

An adequate system of timber-hauling roads is one of the first essentials to the management of forests for continuous high-grade timber production. Close utilization is impossible without accessibility. A road system adequate for utilization of the timber under sustained-yield management also makes all parts of the forest accessible for fire and pest control. It makes possible special forest-management practices to control species or age classes in the interest of insect or disease protection. It also makes it possible to salvage timber killed or dying as a result of the action of forest pests, before deterioration renders the timber worthless. Progress in solving insect and disease control problems will be greatly facilitated by the extension of permanent access road systems in the national forests and commercial forests in other ownerships.

THE PROGRAM FOR FORESTRY

In the job of building up and maintaining our forests for maximum production and service, protection against fire, insects, and diseases is extremely important. Losses from natural enemies, if not prevented, can nullify much good work in forest management, both on public and private land. Owners of forest land cannot be expected to invest in long-term, timber-growing enterprises if the risks remain too high.

With advancing knowledge and experience, forestry services and the cooperating technical agencies have now developed methods for effective control of forest fires and of some serious forest insects and diseases. It is possible and feasible to apply protection against the natural enemies of the forest to a degree that will reduce losses to a tolerable level. The costs of such protection will not be excessive in comparison with the values at stake.

But protection is not the sole answer to the forest problem. Even if the total annual loss from fire, insects, and disease were entirely eliminated, saw-timber drain would still exceed annual saw-timber growth.

Destructive as the natural enemies of the forests can be, the most destructive force in the forests has been man himself. It was largely man's carelessness, wastefulness, and shortsightedness that reduced the forest-growing stocks over large parts of the country below the level needed to sustain even the present rate of saw-timber cutting.

But man can, by the application of positive forest management, build up growing stocks, make and keep forest lands permanently productive. On nearly one-fourth of the commercial forest lands of this country, mostly on the public forest lands and large industrial holdings, he is applying good management now. On another one-fourth, the forest-management practice can be classed as fair. But more than half of the commercial forest land is still being handled poorly or destructively.

Even though full and effective protection against the natural enemies of the forest were available, there would still remain the big

job of raising the general level of forest management in this country to a point where ample and continuous forest products and benefits can be assured.

Adequate protection is a part of the broad program for American forestry advocated by the Forest Service, aimed at building up and maintaining forest growth to meet our future requirements. The program is based on the belief that forest conservation requires the Federal, State, and local governments, and private owners and agencies to act in effective cooperation. It calls for the expansion and intensification necessary to attain adequate fire protection both on public and private forest lands. It calls also for the strengthening of protection against forest insects and diseases.

The program looks also to further encouragement of good forest management through public aids and services to private owners. Technical assistance to private owners on forest management and marketing problems should be made available on a broader scale, especially to the owners of small forest holdings, relatively few of whom are yet practicing good forestry. Forest planting on private lands should be greatly accelerated through increased cooperative aid. A forest credit system is needed to make long-term loans available on terms and conditions suitable for forestry purposes. And as a basic means of aiding forestry and improving wood utilization, and phases of forest research should be strengthened and expanded.

Another part of the comprehensive program for forestry calls for positive action to stop further forest destruction and deterioration and so help maintain a reasonable growing stock as a basis for future production. The plan advocated is a system of public regulation of cutting and other forest practices, administered by the States. Fourteen States already have laws regulating forest practice in one way or another. To assure a consistent Nation-wide pattern, a Federal law setting up basic standards will be needed.

Along with these measures looking to better forest management on privately owned lands, the development, expansion, and intensified management of national and State forests should be vigorously pushed. The public forests are becoming more and more important in helping to meet the Nation's timber needs. They include watershed lands of vital importance to irrigation agriculture, to the water supplies of hundreds of cities and towns, and to stability of stream flow in major streams. Properly developed, these public forests can contribute increasingly to local and national welfare.

Such a broad national program of forestry will require not only the protection of the forests to prevent the loss of existing values, but positive management to build up and sustain forest productivity. A program along these lines, the Forest Service believes, will assure eventual forest abundance.

FORESTRY AND NATIONAL PROGRAMS

During the past year, increased public attention was directed to forestry in the formulation of national policy. This interest may be attributed to a growing understanding of the multipurpose role of forest resources in the economy of the Nation, as well as to the worldwide shortage and the strategic importance of timber products.

The Forest Service sought to gear its programs and policies for maximum contribution to the objectives of defense production and related civilian preparedness. Working through the recently created National, State, and County Mobilization Committees, the Service coordinates its efforts with those of other agencies of the Department of Agriculture.

Defense Production Activities

The National Production Authority in the Department of Commerce is the principal Government agency to which the forest industry looks for guidance on defense production matters. The services of the Forest Service in the Department of Agriculture were offered for use in an advisory and facilitating capacity on those jobs which its widespread field organization and personnel trained in forestry and forest products were especially equipped to handle. An agreement between the Secretaries of Commerce and Agriculture was worked out along these lines. Under this agreement, the National Production Authority is making extensive use of the Forest Service for special studies and reports needed to administer action programs and overcome difficulties in the forest-products field.

The National Production Authority receives applications for accelerated tax amortization and for Government loans for plant expansions, and makes the final recommendations to the Defense Production Administration, the certifying authority for such tax amortizations or loans. When forest products are involved, however, NPA refers the application to the Forest Service for field investigation and advice as to the adequacy of timber supply in the territory tributary to proposed plant expansions.

In the aggregate, the proposed expansions will represent a potential new drain on the country's timber resources of considerable proportions. The Forest Service ascertains whether the timber supply is adequate for proposed expansions of plant facilities and whether such expansions will cause an excessive concentration of installed wood-using plant capacity in the area. The Forest Service does not wish to be a party to any plant expansion that would disrupt existing industry, or that would jeopardize sound long-term developments by causing over-drain and depletion of the forest resources.

Up to August 21, 1951, nearly 250 applications from forest-products industries had been referred by NPA to the Forest Service for review. Most of the applications were for additional expansions in the pulp and paper industry. Others were for increased production of softwood plywood, rayon textiles, and lumber, and for wood-treating plants.

A large proportion of the applications contemplate plant expansions in the Southern States, although many also have been sent in from the Northeast, the Lake States, and the west coast. In many forest areas the installed plant capacity is already much in excess of the growth rate of local timber; but there are a number of places where expansion of plant capacity is possible and desirable, especially where the expansion is based on increased utilization of hitherto little-used species, or mill or woods waste.

During the year, the Forest Service made a number of special surveys and studies to aid and facilitate the defense program. The

Forest Products Laboratory carried on a number of special defense projects for the military services. The Forest Service's Engineering Division continued services in photogrammetry for the Navy Hydrographic Office.

Interagency Programs

Additional responsibility in forestry leadership was placed in the Forest Service as a result of reorganization within the Department of Agriculture aimed at coordinating all services in the field of agricultural resources conservation under the supervision of an Assistant Secretary designated for this purpose.

Planning for River-Basin Development

Interagency committees have been organized for the Arkansas-White-Red River Basin and the New England-New York region. The committees in each of these regions will make a comprehensive survey of the region's water and land resources, and recommendations for their development, utilization, and conservation. Department of Agriculture field committees were established to participate in the investigation and development of these comprehensive river-basin plans. Through representation on these committees, the Forest Service will help to develop the forestry and related phases of the water and land resources problem and to coordinate and integrate them with other agricultural and nonagricultural programs for the regions.

Progress also was made on programs aimed at comprehensive agricultural plans for the Missouri and Columbia River basins. Through representation on the Department field committees for these areas, the Forest Service aided in the development of these plans, particularly with respect to the protection, utilization, and productivity of the forest and range resources. The Forest Service and the Soil Conservation Service jointly prepared an analytical report on the adequacy of flows in the Missouri River to satisfy the water requirements of the comprehensive over-all basin development plan.

Flood-Control Projects and Surveys

Flood-control survey reports were being prepared by the Forest Service, in cooperation with the Soil Conservation Service, for the watersheds of the Connecticut and Merrimack Rivers in New England, the Upper White River of Missouri and Arkansas, Fountain River in Colorado, Boise River in Idaho, San Gabriel-Santa Ana and Santa Clara-Ventura Rivers in California, and of the streams draining the Wasatch Front in Utah, and San Diego County, Calif.

The Forest Service is participating in flood-control projects authorized by Congress in the watersheds of the Coosa, Little Tallahatchie, Los Angeles, Potomac, Santa Ynez, and Yazoo Rivers. On the Los Angeles and Santa Ynez drainages, burned areas were held to a minimum through intensified protection during the dry period of 1950. In the Little Tallahatchie-Yazoo areas in Mississippi, nearly 7,000 acres were planted to trees. Local interest and participation mounted so rapidly that it was not possible to meet all requests for planting stock. Through cooperative action with the State of Mississippi, rapid progress is being made in extending fire protection to all forest lands in these two watersheds.

Family Farming

A provisional report prepared by the Department of Agriculture in connection with its program for the strengthening of family farming in America included recommendations regarding forest-resource policy. This report brought out that present policies and programs for administering the national forests are well adapted to serve the needs of family farming. Because of the multi-resource contributions of the national forests to the national economy and welfare, all farmers share indirectly in the benefits. Many farmers also benefit directly from employment and business opportunities afforded by use of the national-forest resources. National-forest timber is available to them for home or commercial use: forage on national-forest ranges is available to thousands of family farms. Especially important in irrigated areas, the protection and management of national-forest watersheds benefit intermingled, adjacent, and downstream farms. Among numerous other benefits, national-forest recreation and wildlife contribute to the amenities of family farm living.

Established programs of cooperative fire protection, aid in woodland management, and other services to private forest-land owners are particularly helpful to farmers and other small owners. Family farms also benefit from the Forest Service research programs, all of which are aimed partly at stabilization of the economy of rural communities.

THE NATIONAL FORESTS

Cash receipts from national-forest operations during the fiscal year 1951 reached an all-time high of \$56,147,342. The returns to the United States Treasury exceeded the expenditures for protection and management of the national forests by more than \$17,000,000. Receipts even exceeded the total of all appropriations for the national forests, including appropriations for capital expenditures such as purchase of land, road and trail construction, and permanent improvements.

Many individual national forests have been yielding receipts in excess of operating costs for years. Last year was the first year, however, that cash income exceeded all costs for the national-forest system as a whole. Most of the receipts were from the sale of timber. The bulk of the revenue came from less than half of the area. Large portions of the national forests are noncommercial forest lands that produce very little cash revenue, although many of these lands have very high watershed, recreation, and other values. The national-forest system also includes large areas of recently acquired cut-over and burned-over forest land which now brings in little cash income, but which may be expected to bring in more as new timber growth is built up.

The purpose of the national forests, however, is public service, not cash profit. Undoubtedly the greatest returns to the public are not monetary—such things as safeguarding the water supplies of hundreds of cities and towns and farm irrigation systems, reduction of flood danger, community stability and employment resulting from national-forest resource management; the health-giving enjoyment experienced by millions of recreationists; the forests' scenic and inspirational values. The money value of national-forest water sup-

plies for irrigation and domestic use alone has been estimated at \$300,000,000 a year. But it would be impossible and unwise to try to place a dollar-and-cents value on many of these nonmonetary returns to the public.

An amount equal to 25 percent of the gross receipts of the national forests each year goes to the States for distribution to the counties containing national-forest lands. The counties' share of national-forest receipts is used for local schools and roads. An additional 10 percent of receipts is allotted for expenditures on national-forest roads in the States of origin.

Timber Management

The volume of timber cut from the national forests in fiscal year 1951 totaled 4,688,000,000 board feet, the highest for any year since the national forests were established. This was an increase of more than 1 billion board feet over the volume cut in the preceding year. The annual cut has practically doubled since 1943.

A total of 25,451 timber sales was made during the year. Of these, 20,683 were small sales (less than \$1,000); 811 were between \$1,000 and \$5,000; and 905 were over \$5,000. There were 3,052 sales of miscellaneous forest products.

Management of timber for continuous production of usable crops is not possible without markets. The better the markets, the more intensive management may be. Today's management of national-forest timber resources includes practices now considered routine that were mere silvicultural dreams a few years ago.

Lodgepole pine in eastern Oregon was once considered of such little commercial value that it was not included in timber inventories. These tallied only the intermingled ponderosa pine. This same lodgepole pine is now in demand for saw timber at stumpage prices exceeding those obtained for the best ponderosa pine 15 years ago.

In September 1950 there was spirited bidding on an offering of 168 million board feet of medium-quality ponderosa pine in the northern portion of Kaibab National Forest, Ariz., more than 150 miles from the nearest railroad. Kaibab National Forest was created nearly 60 years ago, but until very recently there has been no demand for the timber in this outlying part of the forest, since ample supplies were available in more accessible areas.

For the right to cut 171,000 cords of jack pine, spruce, and balsam fir from the Superior National Forest in northern Minnesota, two pulp companies bid against each other for 6 hours at an auction sale conducted by the Forest Service in Milwaukee in November 1950. Twenty years ago foresters deplored the fact that the timber in this remote area was deteriorating because there was no demand for it.

In May 1951 in the Nantahala National Forest, N. C., 27½ million feet of old-growth Appalachian hardwoods and softwoods sold for almost a million dollars. In a region where lumbering has been extensive, this was a stand of timber that had been left uncut because of difficult operating conditions in the mountains.

These examples show the effects of improved markets on the expansion of management to remote areas of the national forests and to hitherto unused species. Silvicultural practices also are being intensified in many national forests. Demand for pulpwood makes pos-

sible thinnings in crowded young stands of southern pine, for example, and release cuttings in the Lake States to remove an over-story of aspen and enable young softwoods to develop more rapidly. Light, frequent cuts such as these mean reduced mortality and greater yields per acre.

Even without further development of markets the yearly cut of national-forest timber can be increased some 50 percent through the construction of about 4,000 miles of main-line timber access roads during the next few years. Inaccessibility is the principal bottleneck in obtaining timber supplies.

Inventories of timber resources and the preparation of timber-management plans were continued during the year to the extent that it was practicable to finance this work. During the year 18 timber-management plans were approved covering 1,821,000 acres of commercial forest land within the national forests, with a potential sustained-yield annual cut of 290,300,000 board feet. Inventory and management-plan work is a necessary preliminary to timber sales. This work, however, is not up to schedule, and only the most urgent jobs can be undertaken when there is such great pressure for the use of available manpower and funds in preparation and administration of current timber sales.

Ceiling Prices

After the General Ceiling Price Regulation was issued by the Office of Price Stabilization on January 26, 1951, sales of national-forest timber were suspended until appropriate ceiling prices for national-forest stumpage could be determined. Ceiling prices were announced and sale activity was resumed in early February. However, an amendment to the General Ceiling Price Regulation issued in late February forced the Forest Service again to suspend sales activity because of the impracticability of applying the provisions of this amendment to national-forest timber, which by law must be advertised for sale to the highest bidder.

The Office of Price Stabilization came to the conclusion that ceiling prices on stumpage were inadvisable and in April issued Supplementary Regulation 17 which authorized sales without ceiling restrictions. National-forest timber sales were promptly resumed.

National-forest timber is offered for sale at prices which are calculated to allow the purchaser a fair margin of profit and risk. The effects of ceiling prices on lumber and other forest products under the General Ceiling Price Regulation are being taken into account in the stumpage appraisals.

Alaska Pulp-Timber Sale

The Forest Service in July 1951 made final award to the Ketchikan Pulp & Paper Co. on its bid to purchase 1½ billion cubic feet of timber in the Ketchikan pulp-timber unit of the Tongass National Forest in Alaska. Preliminary award was granted to the company in 1948 following advertisement and receipt of bid for the proposed sale. The company in 1951 completed requirements for qualification for final award and made a satisfactory showing of its ability to meet contract terms.

Terms of the sale contract require construction of a pulp mill of at least 300 tons daily capacity. It is estimated that the plant will

employ 800 persons when installations are completed. The proposed mill will be located at Ward Cove near Ketchikan.

The sale was made on the basis of a 50-year cutting contract, with prices to be reappraised in 1964 and at 5-year intervals thereafter. The bulk of the timber covered in the sale is on the northerly portion of Prince of Wales Island. It is 75 percent hemlock, with the balance mainly Sitka spruce and small amounts of Alaska and western cedar.

Provision for conservation of the natural resources of the area was one of the major features of the timber sale agreement. This includes handling of the timber on a sustained-yield cutting plan, safeguarding of salmon spawning streams so important to the huge fishing industry of Alaska, prevention of pollution, and preservation of the significant scenic values.

Sustained Yield Units

The Lakeview (Oregon) Federal Sustained Yield Unit was established October 10, 1950, following a public hearing and lengthy consideration. This action was appealed by the Willow Ranch Co. which operated a sawmill in California, 22 miles from Lakeview. After further study and hearings, the Secretary of Agriculture, on February 19, 1951, upheld the decision of the Chief of the Forest Service approving establishment of the unit.

The Lakeview unit was established under authority of the act of March 29, 1944 (58 Stat. 132; 16 U. S. C. 583-583i). It is designed to aid the stabilization of the local economy by requiring primary processing of national-forest timber from the unit to be done in the communities of Lakeview and Paisley. The several sawmills in these communities have a total installed capacity of some 65 million board feet, but private timber tributary to these mills is practically exhausted. The allowable annual cut from the Federal unit, 50 million board feet, will be sold competitively, subject to the requirement for primary manufacture in the designated communities. Local remanufacture also will be encouraged, to further community stabilization.

A few proposals for additional sustained-yield units are under consideration. Each proposal is subjected to searching study. Many have been rejected. Six units have been established. The first, the Shelton unit, is a cooperative sustained-yield unit involving both national-forest and private lands. The others are Federal units involving only national-forest lands. The units established to date are:

<i>Name</i>	<i>State</i>	<i>Date established</i>	<i>Allowable annual cut (million board feet)</i>
Shelton-----	Washington-----	Dec. 12, 1946-----	100. 0
Vallecitos-----	New Mexico-----	Jan. 21, 1948-----	1. 5
Flagstaff-----	Arizona-----	May 6, 1949-----	61. 0
Gray's Harbor-----	Washington-----	Nov. 2, 1949-----	60. 0
Big Valley-----	California-----	Jan. 27, 1950-----	8. 0
Lakeview-----	Oregon-----	Oct. 10, 1950-----	50. 0
Total-----			280. 5

Reforestation

The Anderson-Mansfield Act of October 11, 1949 (63 Stat. 762), provides authorization for the appropriation of funds to reforest more

than 4 million acres in the national forests during a 15-year period. The authorization for fiscal year 1951 was \$3,000,000. The appropriation actually available was \$1,094,000. Twelve active nurseries produced 32,637,000 trees for national-forest planting during the year. Total area planted and seeded was 46,121 acres.

The act provides increased annual authorizations up to \$10,000,000 for fiscal year 1955 and thereafter. The Forest Service is prepared to carry on this important job when and as the authorized appropriations become available. Five additional Forest Service nurseries are now being used by others. These are the Licking Nursery in Missouri, the Knife River Nursery in Minnesota, the Stuart Nursery in Louisiana, the Hayward Nursery in Wisconsin, and the Wyman Nursery in Michigan. Their combined annual capacity is 591½ million trees. The Knife River Nursery has been leased to a lumber company; the others to State forestry departments. Leases are being negotiated with State agencies for three other nurseries—the Towner in North Dakota, Hugo Sauer in Wisconsin, and the Parsons in West Virginia with a total capacity of 161½ million trees. Arrangements can be made to obtain part or all of the production of these nurseries for national-forest planting whenever the planting program can be stepped up to the rate contemplated in the Anderson-Mansfield Act.

Three years ago, the Ashe Nursery in Mississippi was closed down because of a disease problem which had made the nursery unproductive. Studies by pathologists, soil scientists, and silviculturists resulted in prescription of satisfactory control measures; during the past year, therefore, the Ashe Nursery was returned to production.

Range Management

During 1950 the Forest Service issued 19,900 pay permits to livestockmen authorizing them to graze 1,091,680 cattle, 3,006,185 sheep, and 92 swine on national-forest ranges. In addition, 34,329 cattle, 6,457 sheep, and 1,859 swine kept for domestic purposes by 3,645 owners (exclusive of those who also held pay permits) were permitted to graze under the regulation allowing free permits to local settlers.

Forty-five million acres of range within the national forests is used by cattle and 18 million by sheep. Almost 5 million acres in addition is used in common by sheep and cattle. Six million acres of range is not used by domestic livestock on account of the greater need for its use for timber production, recreation, game animals, watershed, or other purposes.

The great majority of national-forest grazing permittees are small operators. Latest records show that only 7 percent of the cattle permittees graze more than 200 head; only 4 percent of the sheep permits are for more than 4,000 head. The average cattle permit is for 67 head; the average sheep permit for 1,178 head.

Grazing fees on the national forests are adjusted each year in accordance with the market prices of livestock for the preceding year. Because of the high market prices received by producers in 1950 for beef cattle and lambs, the grazing fees reached an all-time high in 1951, averaging 51 cents for cattle and 12¼ cents for sheep per head per month. Total grazing receipts for the fiscal year 1951 amounted to \$4,165,574.

Problem Areas

Among the national-forest lands devoted to grazing use there are several especially acute problem areas, notably in South Dakota, Colorado, Wyoming, New Mexico, and California. Controversies between local stockmen permittees and forest officers have arisen over some of these areas. The Forest Service and the Secretary of Agriculture are giving special attention to the problems involved. During the past year, technicians and administrators not immediately connected with the controversial areas or issues were asked to examine some of the areas and check on the decisions and methods employed by local forest officers in making adjustments in numbers of animals allowed to graze or in the season of use.

Among the problem areas where outside experts reviewed range problems and inspected range conditions and vegetative readiness was the North Warner Mountains Division of the Modoc National Forest in California. The grazing problem here is one of long standing. This is one of a number of areas where the capacity of neighboring ranches for wintering cattle exceeds that of the national forest for summering them. The heavy demand for summer grazing has subjected the range to long-continued overgrazing. Because of determined opposition by a few individual permittees to adjustments in grazing use, it was felt advisable to have the judgment of the local and regional forest officers cross-checked by two Forest Service technicians not directly connected with the local administration. The investigators found unquestionable evidence of the need for easing grazing pressure in the North Warner Mountains, and worked with local people on the program to correct the situation.

A special 1-year study by the Division of Range Research of two range units on the Roosevelt National Forest in Colorado was completed during the past year in line with suggestions contained in a report of the National Forest Advisory Council made in 1949. The major objectives were to determine in an area that has become controversial just how effective adjustments in livestock use had been and whether or not additional adjustments or other measures might be needed to obtain desirable range management and promote satisfactory watershed conditions. Although 96 percent of the usable range area is not producing forage to the full extent of its capability, past reductions in grazing, especially those made in the last 5 to 10 years, have had a beneficial effect on the range. It is believed that the present rate of stocking can be continued for the time being. Watershed conditions, once considered critical in the area, have improved, and a slow recovery of the better forage species is evident. Improved range management and better distribution of livestock should hasten recovery. Several new guides for use in judging the condition and trend of range-watersheds were developed which will be generally helpful to range administrators and stockmen alike in securing a better understanding of grazing management of watershed areas.

The Forest Service is fully aware that reductions in grazing use sometimes have an adverse economic effect upon the operations of grazing permittees. Nevertheless, it has the responsibility of so regulating grazing use as to safeguard both range and watershed values. Maintenance of range productivity is essential to the long-term welfare of the western livestock industry, and most national-forest range

lands are watersheds of vital importance to the Nation's water resources. It was because the Forest Service, in trying to avoid too sudden or too serious effects on the permittees' operations, sometimes moved too slowly in making needed reductions in years past, that there has been continued deterioration of range conditions in some of the problem areas. In making necessary range adjustments, however, the Forest Service will continue to take into account not only the preservation of range and watershed values but the impact on the economic welfare of individual permittees.

Range Improvements

For fiscal year 1951, Congress appropriated \$700,000 for range improvements and approximately \$715,000 for range revegetation on the national forests. The total investment in range improvements, exclusive of range reseeding, up to June 30, 1950, amounted to approximately \$16,560,000. Improvement work accomplished included construction of 27,000 miles of range fence and corrals, 3,500 miles of livestock driveways, 16,000 water developments, control of poisonous plants on 33,000 acres, and control of rodents on 6,255,000 acres. A total of 400,000 acres has been reseeded to palatable forage species.

At the present annual rate of appropriation it will take 65 years to complete the range-revegetation program for the national forests and 30 to 40 years to complete the range-improvement program. Over 50 percent of the funds currently available for range improvements is required for maintaining existing improvements, leaving very little for construction of new improvements.

Advisory Boards

Section 18 of the Granger-Thye Act of April 24, 1950, provides for the establishment of forest advisory boards whenever a majority of the grazing permittees on a national forest or a subdivision thereof petitions the Secretary of Agriculture to form such a board. A tentative regulation was prepared to carry out the provisions of section 18, and after ample opportunity had been given to the more than 800 existing livestockmen's advisory boards, to individual permittees through their associations, and to other interested representatives of the livestock industry to study and advise on this, a new national-forest regulation, G-10, was approved on April 14, 1951.

It will be the policy of the Forest Service to make the fullest possible use of advisory boards constituted and elected or recognized under the Granger-Thye Act. Working through these boards, forest officers will make every effort to give grazing permittees a clear understanding of policies and procedures and to obtain the benefit of their advice in the formulation and application of national-forest grazing policies and programs. Section 18 of the act requires that each advisory board be advised in writing of the reasons for overruling or modifying any of its recommendations, and this requirement is included in the instructions under regulation G-10.

It will be necessary to amend the earlier regulation G-7, which covers "Cooperation With Stockmen," in order to avoid conflicts with the new regulation G-10 and to provide for participation by permittee livestock associations and advisory boards not covered by regulation G-10. A preliminary draft for revision of regulation G-7 and the

attendant instructions has been sent to Forest Service field officers and to representatives of the livestock industry for review and comment.

National Forest Advisory Council

The National Forest Advisory Council is composed of three consultants designated by the Secretary of Agriculture to advise him on policy questions in connection with administration of the national forests. Last year, the Advisory Council, at the request of a joint committee of the American National Livestock Association and the National Wool Growers Association, reviewed certain features of national-forest range management policy. The council conducted a hearing in Denver, attended by representatives of the livestockmen's associations and others.

When reduction in permitted number of livestock on a grazing allotment is necessary, the Forest Service has made it a practice, whenever possible, to make the needed adjustments at a time when a grazing permit is transferred from one party to another. It was believed that reductions at the time of transfer would generally cause less hardship to permittees than at other times. The Advisory Council recommended retention of this policy covering transfer adjustments, but suggested certain measures for clarification of procedure.

The council recommended that the procedures for dealing with grazing trespass cases be incorporated in the National Forest Grazing Manual, so that livestockmen and others could more easily be fully informed of the trespass provisions. The Forest Service has already taken steps to put many of the council's recommendations regarding trespass procedure into effect.

In the public interest as well as in the interest of national forest users, the council recommended that the Forest Service and other Department of Agriculture agencies make every effort to help grazing permittees improve the productiveness of their own lands in order to lessen their dependence on Federal lands.

While numerous magazine and newspaper articles have helped to keep the interested public informed on national-forest grazing matters, the council found that some articles have had adverse effects in leading many stockmen mistakenly to believe that the Forest Service's range-conservation measures are a step toward total elimination of grazing from the national forests. Repeatedly the Forest Service has stated that, on the contrary, its program looks to building up and maintaining the national-forest ranges so that, consistent with the protection of watershed and other values and uses of the range, they can make their maximum contribution to a permanent and stable livestock industry. The council recommended intensified educational and informational effort designed to promote a better public understanding of national-forest objectives.

Watershed Management and Flood Control

Accomplishments in watershed-improvement work, although not always apparent in day-to-day observations, are often significant when viewed over a decade or more. On the Pike and San Isabel National Forests in Colorado, for example, watershed areas where depletion was critical are now beginning to show noticeable recovery

trends as a result of corrective steps begun during the Civilian Conservation Corps period.

A number of special watershed-improvement projects were under way during the past year. In California, the Forest Service was cooperating with the Bureau of Reclamation in rehabilitating lands adjacent to the Shasta and Keswick Reservoirs. These lands were denuded by smelter fumes during early-day mining operations. A combined job of tree planting by the Forest Service and the installation of some 13,000 small check dams for erosion control by the Bureau of Reclamation was in progress.

Several projects in Utah are showing excellent progress. The Tropic project on the Dixie National Forest is an outstanding job in which local water users, stockmen, and the Forest Service are co-operating to control soil and channel erosion and check reservoir sedimentation. Sediment in upstream channels is being controlled by small rock and earthen dams. The work is financed by funds raised by the water users and stockmen through annual assessments against shares of water and numbers of cows grazed. The Forest Service is contributing to the land-management aspects of the project with a range reseeding program that is reducing grazing pressure on the depleted watershed lands. The project appears to be rapidly reducing the sedimentation rate in Tropic Reservoir.

The Weber County Watershed Protective Corporation, a group of civic-minded citizens, is aiding in the purchase of flood and sediment-producing watershed lands above the Pine View Reservoir near Ogden, Utah. The program was started after a heavy flood in 1946. Since then the citizens' group has arranged for the purchase of 6,500 acres of depleted watershed land to be included in the Cache National Forest. The group has raised half of the \$28,000 purchase price through public and private subscriptions; the balance will be met by Federal funds.

Land-restoration measures were started last year on the Mount Pleasant watershed, comprising nearly 12,000 acres of public and private land in and near the Manti-LaSal National Forest, Utah. Largely as a result of overgrazing, this watershed has produced damaging floods 12 times since 1885, the last time in 1946 with damage of more than \$100,000 to the Mount Pleasant community. An active citizens' committee is cooperating with the Forest Service in a program which includes extension of the national forest to include all of the watershed, contour trenching, and reseeding of gullied and denuded slopes.

Emergency Treatments

Two burned areas were given emergency treatment under section 216 of the 1950 Flood Control Act. In Arizona, emergency treatment of the Pinal Creek burned area on the watershed above Globe and Miami, within the Crook National Forest, included airplane seeding of mixed grasses in the ashes on 3,000 acres, supplemented with hand sowing where necessary. In addition, burned pole-size trees on some 300 acres of steep slopes were felled and laid on the contour to control erosion. In New Mexico, some 8,500 acres of Federal, State, and private lands within the Penasco River burn in the Lincoln National Forest were reseeded, largely by aircraft. Trees are to be planted on nearly 400 acres. On some of the critical steep slopes,

burned small trees were felled and other measures taken to help prevent runoff and reduce erosion. The State of New Mexico, private landowners, the United States Army, the Soil Conservation Service, the Production and Marketing Administration, and the Forest Service cooperated in this emergency treatment of the damaged watershed.

Water Developments

Large, multiple-purpose dam projects, such as the Hungry Horse project on the Flathead River in Montana and the Detroit Dam on the North Santiam River in Oregon, will create great reservoirs which will be filled in large part by the runoff from national-forest lands. The reservoirs thus will make it possible for greater benefits to be derived from the water resources of the national forests.

Large reservoir projects also dependent upon and valuable for utilizing national-forest water are being constructed by the Bureau of Reclamation and the Army Engineers in and adjacent to national forests in California. Local communities are reaching into the national forests in this and other States for additional water supplies. Several large reservoirs and generating plants are being constructed by private power companies. Farmers and ranchers continue to build numerous small storage reservoirs in the national forests for irrigation and stock watering. In Alaska, the more accessible of the 200 available power sites are under investigation as potential sources of water and power for the manufacture of pulp from national-forest timber.

The value of the water resources of the national forests thus becomes more apparent each year. Although all this construction for water development is being done by other agencies, the Forest Service is faced with a growing problem of keeping up its transportation system, administrative work centers and improvements, recreation, fire-control, and other facilities that are impaired by the new water developments. Some of the new large reservoirs in the national forests are submerging thousands of acres of what were formerly timber-producing lands. Submergence of roads is complicating the fire protection and timber harvesting on other thousands of acres. Provision is needed for effective restoration of national-forest services so impaired.

Recreation

The public in increasing numbers continues to seek outdoor recreation in the national forests. In 1950 there were over 27,000,000 visits to national forest areas, an increase of 5 percent over 1949. Thirteen million visits were made to public camp grounds, picnic areas, and winter sports areas. The remaining 14,000,000 visits were to organization camps, resorts, summer homes, wilderness areas, hunting country, and fishing lakes and streams. The 27,000,000 visits represented 39,000,000 man-days of recreational use of the national forests.

Moderate charges for camping, picnicking, and swimming at certain of the large, suitably developed recreation areas was continued during 1951. Charges were made at 33 areas, the usual charge being 50 cents per night per party of 6 for camping, and 25 cents to 50 cents per party of 6 for picnicking. Higher charges, up to 25 cents per person per day, were made at four especially well-improved areas in the East:

Sherando Lake in the George Washington National Forest, Va.; Cave Mountain and High Knob in Monongahela National Forest, W. Va.; and Twin Lakes in the Allegheny National Forest, Pa. The Forest Service made special efforts to get responsible concessioners to operate the charge areas, and almost all were operated by concessioners in 1951. Thus the Forest Service was relieved of maintenance and operational costs on these areas. Public reaction to charging continues favorable if the areas are kept clean and properly maintained.

More than 4,000 camping and picnic areas in the national forests remain free to the public. With the limited funds and manpower available for maintenance, however, the operation and upkeep of the free recreation areas by the Forest Service is becoming increasingly difficult as the facilities and improvements become older and as recreation use continues to increase. At many areas sanitary facilities and water systems are no longer satisfactory and do not meet the minimum standards of the United States Public Health Service or the States. Public health and safety are being endangered. Better sanitary control is a "must" if public use of these camp and picnic areas is to continue.

Many recreation areas near population centers are frequently used far in excess of their capacity. Such overcrowding increases the rate of deterioration of the areas and overtakes the already inadequate sanitary facilities. To relieve current overcrowding, the present total capacity of recreation areas—40,000 family-sized units—will have to be enlarged by at least 10,000 units.

Because of inadequate facilities, many people camp and picnic on unimproved areas where there is danger of polluting water used for domestic purposes. The risks of costly fires are increased when the camper builds his fire in locations which have not been provided with fireplaces.

Winter Sports

A major portion of the suitable skiing terrain in the United States is located in the national forests, and the national-forest winter sports areas are heavily used.

The Forest Service held a training school in the Pacific Northwest region to better equip forest officers in the administration of ski areas, including protection of the public from the avalanche hazard. Considerable progress has been made in developing techniques to accurately forecast avalanche hazard. Observation stations, to observe and record climatic factors influencing the occurrence of avalanches, were established at Heather Meadows on the Mount Baker National Forest in Washington and at Berthoud Pass on the Arapaho National Forest in Colorado. These, with the Alta Station in Utah, will afford observations and studies within each of the three major "climatic snow zones" of the West.

Artificially releasing snowslides with explosives, including artillery shells, is proving a successful means of making dangerous slopes safe for the skier. The Utah National Guard has been of great assistance by making a 75-mm. cannon and crew available on short notice for this purpose at Alta.

The Forest Service has received numerous requests from private, State, and other Federal agencies for assistance in combating the

avalanche threat. Two persons were victims of a fast-moving snow-slide in Colorado last winter, and there were several "near misses" throughout the Rockies. Colorado and several other States are evidencing an interest in the application of techniques developed by the Forest Service to make highway travel safer from the avalanche hazard.

Mining and Special Land Uses

In 1951 some 50,600 special-use permits involving 3,870,415 acres of national-forest land were in force. These permits authorize the use of national-forest land for a variety of purposes, including summer homes, resorts, ski lifts, range fences and water developments, telephone lines, railroads, pastures, etc. Some 21,500 permits for uses which serve public purposes and are of a noncommercial nature were issued free. Charge permits yielded \$656,186 for fiscal year 1951.

Interest in summer-home permits continues to exceed the ability of forest officers to plan and survey tracts for this purpose in most national forests. There were 16,550 summer-home permits in force as of June 30, 1951.

In addition to the special-use permits issued by the Forest Service, 466 Federal Power Commission permits and licenses have been issued for dams, power plants, and transmission lines involving national-forest land. Rights-of-way easements and other permits on national-forest land granted by the Department of the Interior number 794 and cover 124,134 acres.

The Secretary of Agriculture and the Secretaries of the Army, Navy, and Air Force have agreed upon a joint policy to govern use of national-forest land for defense purposes. Under the policy, the Department of Agriculture agrees to make national-forest lands available with a minimum of delay when it is necessary for defense needs. The defense agencies agree to request national-forest land only when other less intensively managed lands are not available or suitable. The defense agencies also agree to keep damage to a minimum and to budget for restoration funds.

Gas and Oil Leases

There has been much interest in gas and oil leases on national-forest lands, especially in western and southern national forests. The Forest Service made 163 reports on applications for acquired land leases under the act of August 7, 1947. In addition, recommendations were made on 1,500 applications for oil and gas leases under the Mineral Leasing Act of February 25, 1920. All together, 3,890 leases are in effect on the national forests, covering 3,445,643 acres. All leases are issued by the Bureau of Land Management, but the Forest Service is responsible for certain land-protection stipulations. Receipts from oil and gas leases on national-forest land withdrawn from the public domain are not credited as national-forest receipts, but are deposited and distributed as other receipts from leases issued under the Mineral Leasing Act. Receipts from oil and gas leases on acquired national-forest lands are credited to the Forest Reserve fund and amounted to \$142,846 in fiscal year 1951.

A set of special stipulations were agreed upon for all oil and gas leases in the Condor Sanctuary, in Los Padres National Forest, Calif. The Department of Agriculture, Department of the Interior, Izaak

Walton League, Audubon Society, and the oil industry cooperated in working out special stipulations under which oil and gas lessees could operate without detriment to the rare California condor which nests in the area.

Mining Claims

There has been considerable discussion of the United States mining laws, and the need for revision of those laws, in newspapers and periodicals and at meetings of conservation organizations. The Izaak Walton League, Society of American Foresters, and National Parks Association have passed resolutions favoring a change in the mining laws, to provide for leasing of minerals or for a separation of the surface and mineral rights in connection with mining claims filed on Federal lands.

Hundreds of new mining claims have been filed on national-forest lands during the past year. Many of these claims include valuable stands of timber. Timber values of \$25,000 per 20-acre claim are not uncommon in the big-timber country of Oregon, Washington, and California. Others claims are located so as to control access to large bodies of merchantable timber owned by the United States. In the opinion of the Forest Service, many of these claims have been located for other purposes than mining.

Every year adds new evidence that the mining laws must be revised if the Forest Service is to manage the national forests in accordance with the best principles of land management. The preemptory right to take and use or abuse public land in a mining claim which the mining law grants makes effective land management impossible in many areas.

Minerals are a resource of national-forest land. They should be developed and exploited for the benefit of our national welfare, but there must be reasonable control on damage to other resources.

Separation of surface and mineral rights is one solution to the problem. It is a solution which would not jeopardize the interests of the legitimate miner, but it would prevent the abuse of the mining laws and interference with the management of the national forests.

Leasing for all minerals, as lands for exploitation of oil and gas and certain other minerals are now leased, rather than outright patenting of land for exploitation of the minerals, would be another satisfactory solution which would not impair the rights of the legitimate miner.

Wildlife

Close cooperative relations in wildlife management are maintained between the Forest Service and the State game and fish departments, and one of the primary aims of the Forest Service is to strengthen these relations and make them more productive. Although cooperation is concerned with many matters, it centers around the States' responsibility in providing and enforcing the laws and regulations which govern the protection and utilization of wildlife on the national forests, and the responsibility of the Forest Service to maintain environmental conditions suitable for wildlife on these Federal lands.

Cooperation in nearly all States is facilitated by special agreements. In some States a broad cooperative agreement outlines responsibilities of the Forest Service and the State. In others specific cooperative

agreements provide for very intensive management of specified national-forest areas and the sharing of special hunting and fishing fees which are collected by the State. Agreements in this latter category are in effect in the States of Arizona, Florida, Georgia, Alabama, Tennessee, North Carolina, and Virginia.

Legislation recently passed in West Virginia will strengthen and expand cooperative wildlife management in the national forests of that State. The legislation provides for the collection by the State of a special fee of \$1 for hunting and \$1 for fishing on national-forest lands. A similar method has worked exceptionally well in Virginia for a number of years. The funds collected by the States are used in the national forests for intensive and cooperatively executed wildlife habitat and management programs.

Habitat Improvement

In the Allegheny National Forest in Pennsylvania a special habitat-improvement program finished its second successful year under a cooperative agreement. Here special emphasis was placed on the creation and development of openings for wildlife in dense forest areas. Although primarily for small game, such as rabbits and grouse, these openings and their food plantings were of considerable benefit to the Allegheny National Forest deer herd.

Habitat improvement received emphasis elsewhere in Forest Service-State cooperative management programs. In Arizona, water developments are helping to improve habitat for game. Quail range was improved and extended in the Tonto National Forest by the installation of special watering devices. In the Kaibab National Forest deer and turkeys benefited from new water developments.

In Idaho, a cooperative program to improve browse forage for big game was undertaken. The program included extensive plantings of bitterbrush, a highly palatable deer food, on the Boise National Forest. In the Clearwater National Forest special studies were made on techniques of stimulating low-level sprout growth in browse stands that had grown beyond the reach of deer and elk. In Michigan cooperative habitat management included provision for maintaining a special habitat for sharptail grouse on 24,000 acres of national-forest land. Some special food plantings were also being made in the national forests in the Lake States.

Cooperative programs concerned with big-game management included many studies of forage utilizations, sex and age ratio studies, and joint meetings of State, Forest Service, and other agencies for the purpose of recommending regulations for hunting seasons, bag limits, and special hunt procedures. Among the States which had outstanding examples of cooperative hunt-management planning on a State-wide scale were Utah and Colorado. In these States the planning also involved other interested Government agencies and special-interest groups such as sportsmen and livestock operators. In the far West, the Forest Service and the States of California and Oregon are jointly continuing a sound operating deer-management program in the Modoc and Fremont National Forests.

Many Hunters and Fishermen

The popularity of the hunting and fishing in the national forests is well indicated by the large numbers of hunters and fishermen who

visit the forests each year. The estimate of their numbers for fiscal year 1950 was 1,350,000 big-game hunters, 608,000 small-game hunters, and 3,160,000 fishermen. No estimate was made of the amount of small game and fish taken, but the estimated harvest of big game was 356,000 animals. Among the many species taken were deer, elk, bear, mountain goats, Bighorn sheep, antelope, and moose. The take of deer, estimated at 304,000 head, far exceeded that of all other species.

Improvements and Facilities

Roads and Trails

A total of \$13,648,000 was made available by congressional appropriations during fiscal year 1951 for maintenance and construction of national-forest roads and trails. This total included \$10,348,000 in the regular annual appropriation, and an additional \$3,300,000 in the Third Supplemental Appropriation made in the late spring of 1951. There remained an unappropriated balance of \$13,112,000 of forest-development road funds authorized by the Federal Aid Highway Act of 1950.

Of the \$3,300,000 supplemental appropriation, \$2,500,000 was made available for the construction of timber-access roads, and \$800,000 for the replacement of bridges and restoration of roads and trails damaged by severe storms in California during the autumn of 1950.

In addition to appropriations made available under the Federal Aid Highway Act, \$3,360,039 of 10-percent funds (representing 10 percent of national-forest receipts authorized for expenditure on forest roads) became available in March 1951. These funds were scheduled chiefly for replacement of unsafe bridges and for reconstruction, resurfacing, or construction of roads used for hauling timber.

The national forests are still woefully deficient in suitable road mileage needed for maximum utilization and proper management of the timber. Construction of approximately 4,000 miles of main timber-haul road mileage would make accessible enough timber to increase the sustained annual cut to a total of some 6 billion board feet each year. An extended road system would also permit the salvaging of large amounts of insect-, disease-, and fire-killed timber and wind-thrown timber which is now being lost because of inadequate transportation facilities.

In some national forests, especially in the Western States, operators logging on public land are equipped and financed to build part of the needed timber-access roads. The Forest Service requires the purchasers or loggers of national-forest timber to build most lateral or side roads for timber hauling and all logging spurs. However, regardless of whether timber road construction is financed initially by the Government or by the logger, the Government stands the cost in the end. Appraised stumpage prices must necessarily be lower where the road building is done by the purchaser of Government timber. Government-built roads, on the other hand, greatly enhance the value of Government-owned stumpage. Since accessibility helps to make Government timber available to many purchasers who would be unable to finance large-scale advance road construction, the Government-built roads afford more flexibility in planning sales, more competition in bidding, and greater opportunities for the small logger.

Transportation System

The existing national-forest transportation system consists of 22,664 miles of forest highways, 111,256 miles of forest-development roads, 129,210 miles of trails, and 112 landing fields. States and counties maintain the forest highways as a rule, and in addition maintain partially or wholly about 10,000 miles of forest-development roads. Loggers and others who use national-forest roads maintain 3,000 miles of forest-development roads.

Of the existing transportation system, 10,296 miles of the forest highways and 57,683 miles of roads are unsatisfactory for present-day traffic, while 35,000 miles of national-forest trails are inadequate for forest-fire control and unsuitable for public use. These unsatisfactory conditions are being corrected as funds become available, but at far too slow a pace to keep abreast of modern traffic requirements. Priority has been given in recent years to the improvement of those highways and development roads that make national-forest timber accessible.

A substantial part of the road funds annually available to the Forest Service is now being spent for the replacement of deteriorated and unsafe bridges with permanent-type structures, culverts, or fords. A great many of the older bridges and temporary-type bridges built by the CCC and during World War II are wholly inadequate for the heavy loads now using the roads. Since the replacement program was started following World War II, 2,354 old or temporary-type bridges have been replaced with 757 permanent-type bridges and 1,597 culverts, at a cost of \$7,682,400. An additional 652 bridges are scheduled for replacement in 1952. There will still remain some 7,000 bridges which are inadequate for present-day loads. Some of the roads must be closed to traffic until bridges can be replaced.

A few more airplane landing fields are planned in or adjacent to national forests to meet fire-control and other special needs. Many of the existing fields need to be improved and extended so that they can safely accommodate the aircraft now being used extensively for fire protection and insect control. Forest Service landing fields are far from elaborate affairs. Usually they consist of little more than a cleared, leveled, and graded strip in the forest, a wind sock, and a telephone. With cooperation of the Civil Aeronautics Administration and some local cooperation, the landing strips are gradually being improved. A few have been given a blacktop surface treatment. A blacktop or concrete surface on at least a portion of a strip reduces the frequency and expense of aircraft-motor overhaul. The dust and dirt that a motor picks up from an unpaved strip during the warming-up period causes high motor maintenance expense.

National-Forest Properties

The national forests and related properties were increased during the fiscal year 1951 by a net of 276,449 acres. This increase extended the area of these properties to 181,034,882 net acres out of a total gross area of 229,257,719 acres within their defined limits. The properties included the 151 national forests, 33 purchase units established with the approval of the National Forest Reservation Commission pursuant to the Weeks law, 16 experimental areas, and 9 land-utiliza-

tion projects currently under the administration of the Forest Service.

An additional 92,000 acres acquired by the United States for rural rehabilitation purposes were administered by the Forest Service during the fiscal year. The Forest Service also served as custodian of the Federal interests in 445,889 acres of land-utilization-project lands which the several States are managing for forestry and related purposes under lease and cooperative agreements.

Boundary Changes and Readjustments

Two minor boundary changes were effected during the fiscal year. Public Land Order 707, dated March 16, 1951, extended the boundaries of the Ouachita National Forest in Arkansas to include 4,866 acres of privately owned lands which are suitable for acquisition for timber production and watershed protection; and 4,171 acres of private land not considered desirable for national-forest purposes were eliminated from the forest boundaries by the same order. Public Land Order 721 of May 2, 1951, excluded 8,186 acres, all but 2 acres of which were privately owned, from the Olympic National Forest in Washington.

Land Purchases

Further consolidation of Federal ownership in 26 national forests and purchase units was accomplished during fiscal year 1951 through approval by the National Forest Reservation Commission of the purchase of 180 tracts involving 24,430 acres. This included 16,183 acres situated within 22 purchase units previously established under the Weeks law. These purchases will aid in consolidation of the units and promote timber production and conservation of watersheds. Control of soil erosion and flood damage will be aided by the acquisition under authority of certain forest-receipts acts of 2,934 acres contained in eight tracts approved for purchase during the year in four national forests in California, Utah, and Nevada. Purchase of 43 tracts containing 5,313 acres of privately owned land in the Superior National Forest, as authorized by Public Law 733 of the Eightieth Congress, was approved during the year to facilitate the efforts of the Forest Service to preserve the primitive environment of the Superior Roadless Area.

Forest Exchanges

Applications for the exchange of 178 tracts of privately owned, county, or State lands within or near the national forests for national-forest lands or timber, or land-utilization-project lands, were reviewed and approved during the fiscal year; 199 exchange cases were consummated and the Government accepted title to 299,698 acres of land within or adjacent to national forests. The Government granted or will grant in exchange for such land 95,838 acres of national-forest or land-utilization-project lands and cutting rights to 205,691,000 board feet, more or less, of national-forest timber.

Miscellaneous Acquisitions and Disposals

Eight tracts involving 332 acres were donated to the Government for national-forest purposes. Two of these tracts, including about 7 acres, were primarily for administrative sites and the balance are

suitable for timber production and other national-forest purposes. Twenty-two tracts were purchased pursuant to the act of March 3, 1925, as amended, for sites for ranger stations or other administrative facilities, or as additions to existing sites.

One tract comprising 22 acres was conveyed pursuant to section 16 of the Federal Airport Act, and 25 small sites, each of 5 acres or less, occupied as homes by residents of Alaska, were eliminated from the Chugach and Tongass National Forests so the occupants may obtain land patents.

Continued consolidation of national-forest units to promote more effective and economical watershed protection and to assure restoration and perpetuation of the soil, timber, recreation, water, and other resources is essential. Pressures on our remaining resources are continually growing, and the need to build up renewable resources and conserve those that exist becomes more imperative as the demands upon them increase.

There is particular need to acquire those intermingled private lands within the national-forest boundaries that are especially significant from the standpoint of fire protection, sustained timber yield, or flood and erosion prevention, or which cause undue administrative expense. Acquisition of these "key" tracts will not only simplify management and promote conservation but will act to protect the public investment in the surrounding national-forest lands. A moderate land-purchase program looking especially to such tracts is considered fully justified during the emergency period.

COOPERATION IN STATE AND PRIVATE FORESTRY

States and private owners of forest land receive cooperation from the Forest Service in the application of sound forest-management practices, in the maintenance of organized protection of forest lands against fire, and in the production and distribution of planting stocks for windbreaks, shelterbelts, and farm woodlands. The Forest Service also administers the agricultural conservation program of the Production and Marketing Administration as applied to the naval stores industry.

Federal cooperative assistance in the prevention and suppression of forest fires on State and privately owned forest lands is continuing, under authorization of the Clarke-McNary Act, in 43 States and Hawaii. This work is reviewed in connection with the discussion of forest-fire protection earlier in this report.

Forest Management Assistance to Woodland Owners

On July 1, 1951, the Cooperative Forest Management Act of 1950 became effective. It replaces the Norris-Doxey Cooperative Farm Forestry Act under which the Federal Government has cooperated with State forestry agencies for more than a decade in providing technical assistance to farm owners in the management of their woodlands and in the utilization and marketing of their products.

The activities of the Norris-Doxey farm or project foresters were broadened to cover technical assistance to small sawmill operators and other processors of primary forest products. Furthermore, all privately owned forests, farm or nonfarm, are made eligible for management advice and assistance.

In the work carried on under the new Cooperative Forest Management Act, attention will be given primarily to the 41 $\frac{1}{4}$ million small owners of forest lands. These farmers and nonfarm owners, whose forest-land holdings average only 62 acres each, are the ones most in need of the service. The Cooperative Forest Management Service foresters will continue to provide technical advice and assistance along such lines as making simple forest-management plans; marking trees to be cut; estimating timber volume; determining proper cutting methods; marketing forest products; and planting, thinning, pruning, and protecting against fire, insects, and diseases.

In fiscal year 1951 some 240 project foresters aided 4,718 woodland owners in 38 cooperating States. They were responsible for improved forest-management practices on 2,558,091 acres of forest land. The woodland owners received nearly \$16,000,000 in cash through harvesting and sale of over 721 million board feet of saw timber and other forest products, including 1,449 barrels of gum naval stores, 189,273 gallons of maple sirup, holly, Christmas trees, tree seed, pine cones, and other miscellaneous products.

The project foresters were unable to fill all requests received, and at the end of the year, more than 4,700 requests for assistance remained unfilled. Only about one-half of the area needing this kind of assistance now has it. Also, in some States the existing project areas are too large to permit adequate coverage of the forest properties in need of technical forest-management assistance.

Farm Forestry Extension

Educational work in farm forestry is conducted by the State agricultural extension services of the land-grant colleges, in cooperation with the Department of Agriculture's Extension Service, and with the Forest Service as the subject-matter agency. Forty-five States and one Territory now employ one or more extension foresters. Other Federal, State, and private agencies are brought into the picture to make the program as effective as possible.

Farm forestry extension is a program of nonresident instruction carried on through leaflets, bulletins, circular letters, information in newspapers and farm journals; method-and-result demonstrations; visual aids such as motion pictures, slides, and fair exhibits; radio and television; and through meetings and other contacts with farm people. The State extension forestry specialists work closely with the county agricultural agents. Topics covered include farm woodland management, utilization of farm wood- and products on the farm, marketing of products, timber estimating and appraisal, planting windbreaks and shelterbelts, preservative treatment of farm timbers and fence posts, wildlife management, prevention of farm fires, and production of naval stores and maple sirup.

Important among last year's activities were demonstrations of tree-planting machines for establishment of windbreaks, shelterbelts, and future timber crops. There were also demonstrations in the use of the power saw. This labor-saving device has created a desire on the part of many farmers to do their own logging, and thus has caused them to become interested in log grades, log scaling, potential markets and market prices, and in instituting good cutting practices in their farm woodlands.

Through the 4-H Club program, a special effort is being made to provide rural youth with an understanding and appreciation of forestry. In this work, 167,745 boys and girls last year received training in forestry, and 572,917 in fire and accident prevention.

Cooperation in Tree Planting

The production of trees in State nurseries in fiscal year 1951 again passed all previous records. The output approximated 400 million trees, as compared with 350 million in 1950, 239 million in 1949, 157 million in 1948, and 84 million in 1947. These figures represent a fivefold increase in 5 years and an encouraging advance toward the suggested goal of a billion trees a year. This progress was a remarkable achievement on the part of the landowners, States, and organizations interested in the reforestation of millions of acres of denuded and unproductive forest land.

All but five States are now conducting tree-distribution programs with Federal cooperation under provisions of the Clarke-McNary Act. One of these five conducts a program without Federal cooperation. Two of the States are served to some extent by adjoining States. Four States operate no nurseries but distribute trees which they buy from private and Federal nurseries. Eighty-three nurseries, in all, are operated by the States and Territories. A number of these nurseries are being enlarged and several new ones are planned.

Prior to fiscal year 1951, trees produced under the Federal-State cooperative program could be distributed only to farmers. The States could not receive the benefit of Federal help for production of trees shipped to nonfarm forest landowners. The Eighty-first Congress amended the law, extending Federal aid to cover production and distribution of trees for nonfarm forest planting, and increased the authorization for such work. The increased production in 1951 is at least partly due to this amendment.

Tree planting is receiving active help and encouragement from many agencies and groups, including schools, service clubs, and conservation groups, private citizens, forest industries, and business institutions such as banks, railroads, and chambers of commerce. Their efforts to get more planting done are succeeding so well that the demand for trees still exceeds the supply, despite the 500-percent increase in output during the past 5 years. These interested organizations encourage tree planting in many ways. For example, 4-H Clubs, Future Farmers of America, and other youth groups are giving training in tree planting, and in promoting planting on community project areas or on the home place. Clubs, banks, and business houses are making tree-planting machines available in their localities; industries and soil-conservation districts often give trees to landowners; sportsmen's groups and schools plant tracts of available idle land.

Naval Stores Conservation Program

The Naval Stores Conservation Program, a part of the general agricultural conservation program authorized by the Soil Conservation and Domestic Allotment Act, is administered by the Forest Service for the Production and Marketing Administration. Under the program, payments are made to turpentine farmers who carry out good naval stores and forestry practices in their woods.

The requirements of the program stipulate that no trees are to be cupped below the minimum tree sizes—9, 10, and 11 inches in diameter; selective cupping, patterned on selective cutting, is to be practiced; and only trees previously worked are to be cupped. In addition to these requirements, on which payments are based, all payments take into consideration the care exercised by farmers in preventing and suppressing wildfires and in following good timber-cutting practices.

In 1950, 3,080 naval stores producers, working 51,000,000 trees, participated in the program. This was 35 percent of the total number of producers and 75 percent of the total number of trees worked in the naval stores region.

In addition to checking program compliance, the naval stores conservation program inspectors are actively promoting the use of chemical stimulation to increase gum production. It was largely due to their efforts that the practice of chemical stimulation, followed by 5 percent of the producers on 6 percent of the faces in 1949, was in 1950 followed by 10 percent of the producers on 17 percent of the faces.

RESEARCH

Forest Management

The field of forest-management research encompasses a wide range of subject matter. Research is currently being conducted on many different projects such as planting, stand improvement, genetics, mensuration, cutting methods, and silvics—the study of the habits or behavior of forest trees. Much of the progress from year to year represents advances on the road to solution of major problems, the final answers to which are still not fully known.

Understanding the Forests

Much of the early research in forestry consisted of intensive studies of growth habits of individual trees. As more and more was learned of trees as individuals, they were classified according to their capacity to grow, to produce lumber of high quality, to resist attack from insects and disease, to produce seed or a new crop of trees, and to tolerate varying degrees of shade and competition. The next step naturally would be to study trees growing in groups or communities where conditions of age, density, composition, and site are more or less similar. At the California Forest and Range Experiment Station such a study has resulted in a new understanding of the complex pine forests of that region. These forests, seemingly growing without order or any semblance of uniformity, have been found to be composed of many small divisions in which certain forest conditions are similar. Distinct divisions or units of area representing similar conditions were readily discernible. They varied from one-tenth to several acres in size. Several major forest conditions and many minor variants of these conditions have been identified, described, and classified, making it possible to prescribe precise silvicultural treatments for any condition encountered in the timber-harvesting operation. A sampling procedure designed to determine the total area occupied by each forest-condition class was also developed. This makes it possible, with the aid of growth studies now completed, to compute more precise cutting budgets for sustained-yield management for these forests.

Among the most complex of all forest types to be systematized into a set of forest-condition classes are the bottom-land hardwoods of the South. Eight separate forest types are present, 60 variants occurring within the types that need special silvicultural consideration. This project was completed by the Southern Forest Experiment Station and the results have been made available in a guide for the management of southern bottom-land hardwoods. With 30,000,000 acres of these forests in the South and a potential growth under proper management of more than 7,000,000,000 board feet of excellent timber per year, the value of such information is readily apparent.

In the Southwest the results of 40 years of forest research were summarized in a monograph on ponderosa pine. The publication provides information on cultural procedures, soil and climatic requirements, volume and growth tables necessary to management, and methods of regenerating these forests either artificially or naturally. It discusses also the role of damaging agents such as wind, lightning, fire, rodents, insects, diseases, and browsing animals in the history of these forests. The work represents the lifetime contribution of a forest research worker, but less than one-quarter of the life span of a tree from its beginning to maturity.

Forest management in the tropics involves many unusual and vexing problems. For example, determining the age of trees by the customary technique of counting rings has proved unreliable with tropical trees. An answer to this problem for the virgin rain forest of Puerto Rico at least is now in sight. A new method being developed at the Tropical Forest Experiment Station is based on a mathematical relationship of growth with time.

Renewing Forests

What to plant, when to plant, where to plant, how to plant, how to care for plantations, what enemies to guard against, how to plan large-scale reforestation in the Lake States—these subjects are all covered in a new bulletin based on 20 years of research by the Lake States Forest Experiment Station.

The problem of reforesting the 190,000 acres of strip-mined coal lands in the Midwestern States seems less formidable in the light of an examination by the Central States Station of 26 successful coal-company plantings in Indiana. On moderately acid spoil banks, the growth of hardwood species, planted in mixtures which included black locust, has been good. These trees have grown an average of 1.5 feet in height per year, which compares favorably with the growth of trees in natural forest stands.

Direct seeding after burning or disking has given satisfactory stands of both slash and longleaf pines at Alexandria, La. The burning or disking improves the seedbed, lessens first-year grass competition, and destroys cover which harbors seed-eating rodents. Cheaper reforestation methods are needed for the large acreage of pine forest land in the South that now has no natural pine seed source. The experiments indicate that direct seeding, although vulnerable to drought, rodents, and birds, can be done for little more than one-third the cost of planting nursery-grown trees.

In the northern Rocky Mountains where natural regeneration has been unsuccessful following broadcast burning, direct seeding has been successful on burned areas baited for rodents with thallium sul-

fate-treated sunflower seed. At the end of the first growing season, approximately 75 percent of the experimental seed spots contained one or more seedlings. These results together with previous findings for other species in the same region make it clear that successful direct seeding depends upon (1) absence of seed-destroying rodents, (2) absence of vegetal competition, (3) sites not subject to severe drying, and (4) favorable weather during the first growing season.

The testing of hybrid poplars and the breeding of important native forest trees was accelerated in the Northeast. At Beltsville, Md., the more vigorous hybrid poplars have grown to an average height of more than 12 feet in 2 years from dominant cuttings. On the Hopkins Experimental Forest in Massachusetts, where the growing season is shorter, the average height of the best hybrids exceeds 8 feet in 2 years. In the breeding tests seed was produced satisfactorily from 30 hybrid combinations, including both hardwoods and softwoods.

Evidence continues to point to the superiority in resistance to blister rust of hybrids from crossing American and Asiatic white pines over crosses of American white pines. A back cross—a straight cross followed by a cross between the hybrid and one parent—of Jeffrey pine and Coulter pine has been produced by the Tree Breeding Institute in California that shows a marked capacity to survive in plantations. One of the most remarkable hybrids to be developed at the institute is a three-species hybrid of the three-needled pines (Jeffrey and ponderosa) and the five-needled pine (Apache). It has shown exceptional vigor and the results attained in this cross suggest the possibilities of combining the resistance of Coulter pine to pine reproduction weevil with the rapid growth of still another hybrid. Such a future hybrid might also be resistant to western pine beetle.

Tending Our Forests

Starting new forests where they must be replaced or where they do not now exist calls for special knowledge and special techniques. Making the most of existing forests—in volume of materials produced, in income derived, in protective, recreational and other benefits—is even more important.

The forest manager must strive constantly to maintain trees of favored species in his stands. More and more is being learned of various trees in this respect. Tests during the past 2 years on the Allegheny National Forest have disclosed that black cherry, a valuable tree in Pennsylvania and New York, is dominant in the reproduction following only two types of cutting: (1) Narrow strip cuttings in 40–60-year-old second growth, and (2) small group openings in second growth cut to diameter limits of 8 inches or less.

That proper partial cuttings in hardwood stands reduce mortality losses from wind was illustrated again recently on the Argonne Experimental Forest in Wisconsin. Volume losses on an area partially cut during the spring were only one-seventh those on adjacent uncut stands, when one of the most severe windstorms on record swept the area the following October.

Increasing markets for thinnings has brought an acute need for thinning guides for all important timber species. Such guides are best developed by careful thinning experiments that begin with sapling stands and end with the final harvest of mature timber. Such studies

would require from 50 to 150 years to complete. At the Pacific Northwest Forest Experiment Station, however, a new interim guide has been developed for Douglas-fir. This guide gives the number of trees to which stands of any given average diameter and height should be thinned to obtain optimum yields.

Cutting practices on most small woodlands are poor. In an effort to demonstrate that income at short intervals can be obtained while improving them, a number of small forest areas of 40 acres or so have been dedicated to this purpose on experimental forests throughout the country. While not spectacular, results continue to be encouraging. A reasonable return for labor expended seems possible in most cases even while converting run-down properties to managed forests. On the Massabesic Experimental Forest in Maine, returns for stumpage and labor expended in improvement cuttings on a white pine woodlot were \$1.33 per man-hour. For the past 5 years on a northern hardwood farm woodland "forty" in the Upper Peninsula Experimental Forest in Michigan, returns per man-hour have ranged from \$1.10 to \$1.52 and averaged \$1.31. In tests with pine-hardwood stands in Alabama comparable returns were \$0.80 per man-hour on a poorly stocked tract and \$1.11 on a moderately well-stocked unit.

In the current defense effort, how to use men more productively becomes increasingly important. Effort has been made in forest-management research during the past year to determine ways to conserve manpower in woods operations through improved logging methods. On the Massabesic Experimental Forest in Maine, for example, changing from 2-man to 1-man power saws in felling and bucking white pine trees reduced the time required per thousand feet of logs by 1 to 1½ man-hours. Again, on the Fernow Experimental Forest in West Virginia the use of power saws for felling and bucking, and tree-length logging with tractor-drawn sully, gave about 25 percent greater production than the use of conventional cross-cut saws and the practice of ground-skidding with teams.

Usable methods of prolonging the flow of gum by sulfuric acid are now available to the naval stores industry as the result of past research. These methods saved the industry about one-half million dollars in 1950. There is need, however, for a chemical safer and easier to use than sulfuric acid. Initial experiments now show that 2,4-D solutions are producing about the same yield of gum as sulfuric acid for the first 2 years in working on slash pine. These preliminary results lend encouragement to the belief that effective but safer chemicals will eventually be available to the industry.

Range Research

Some 950,000,000 acres of range land, largely in the West and South, have a major part in the production of more than half of this country's cattle and calves and three-fourths of the sheep, lambs, and wool. Range research is emphasizing the development of practices that will obtain greater values from the range resource and increase livestock production. The high demand for meat, especially beef, in the defense-emergency period points up the necessity for improving and making more efficient use of the Nation's range lands.

Grazing-management practices have been and are being developed that will maintain ranges now in satisfactory condition and improve

ranges not now producing their maximum in livestock products. On some badly deteriorated western ranges where natural recovery under good management would be extremely slow, research on range reseeding has laid the foundation for quicker range recovery. More than 8,000,000 acres of range lands have been successfully reseeded in the past 15 years as research has pointed the way. Continued research on what, how, when, and where to seed, and how to graze these reseeded stands will bring similar success to other ranges.

Value of Reseeding Shown

Cooperative grazing tests, which have now extended over a number of years, show the value of reseeding depleted range lands to crested wheatgrass. On a 46-acre area at the United States Range Livestock Experiment Station, Miles City, Mont., for example, an average of 80.5 pounds of beef per acre has been produced annually during an average period of 1 cow-month of grazing for the past 11 years under spring and early summer grazing. Rainfall there has averaged 14 inches a year. At the United States Sheep Experiment Station, Dubois, Idaho, with 11 inches average rainfall, seeded crested wheatgrass has for the past 10 years furnished forage on an average 2 weeks earlier than native range plants, and has furnished 5 sheep-months per acre annually of early spring and fall grazing. Near Ephriam, Utah, a range area with about 12 inches precipitation has, for 8 years, provided 5.8 sheep-months per acre annually of spring and fall grazing. Twenty rather large areas of typical reseeded range, totaling 14,000 acres in Idaho, Utah, and Nevada, have furnished from 300 to 1,700 pounds per acre of air-dry herbage. Grazing capacities from these areas have been from 2½ to 10 times greater than comparable adjacent unseeded range. Annual rainfall at these areas varies from 9 to 20 inches, half of them having 12 inches or less each year. On one sagebrush area near Gunnison, Colo., intermediate, pubescent, crested, and tall wheatgrass all yielded over 1 ton of air-dry herbage per acre as compared to 140 pounds for native grass on a comparable adjacent unseeded area.

Among the more favorable sites for range reseeding in the West are those taken over by big sagebrush and now producing very little palatable forage. Considerable breakage and lost crew time resulted when heavy disk plows and other disks designed primarily for cultivated farming operations were used on rough, rocky, range lands. Through research and experimentation, the Forest Service has developed a brushland plow which has removed big sagebrush more effectively with greatly reduced breakage and at about half the previous costs. The plow has paired disks, mounted on an arm with spring tension so that each pair will automatically lift itself over rocks, stumps, and piles of brush without affecting the operation of the other disks and without undue strain on the plow. The brushland plow, although heavier, is operated with less tractive power than farm disks with the same width of cut. This plow, now available for commercial production, will greatly reduce reseeding costs and further encourage improvement on millions of acres of range land throughout the West.

Control of Undesirable Plants

The control of noxious and poisonous plants and undesirable shrubs on range lands is being studied to find out how they can be reduced and replaced with valuable forage plants.

Halogeton, an introduced poisonous plant first found in this country by a Forest Service range researcher near Elko, Nev., in 1934, has now spread to six States, from California to Montana and Wyoming. It is a serious threat to the livestock industry, especially in northern Nevada, southern Idaho, and northern Wyoming. It is a prolific seeder and spreads rapidly. It establishes itself where natural vegetation has been depleted, and is most abundant along trails, roads, and in livestock concentration areas.

Halogeton is extremely poisonous to sheep and cattle. Being a hardy annual, it offers a serious problem of control. However, research on range reseeding has indicated suitable species and adaptable methods for reseeding many areas where halogeton infestation occurs or is likely to occur. Limited studies in Nevada show that the seeding of crested and intermediate wheatgrasses effectively controls halogeton on burned sagebrush ranges. Studies of reseeding of unburned halogeton-infested ranges indicate that established stands of it can be reduced. Unfortunately, halogeton occurs on many dry, saline desert sites where methods for successful reseeding are yet unknown. This poses an urgent and critical research problem.

Mesquite invasions in the Southwest constitute a serious range problem. Mesquite now occurs on some 70 million acres and is continuing to spread and thicken in abundance wherever it secures a foothold, often in the choicest grassland areas. A report is now being prepared on the results of some 10 years experimentation in control of velvet mesquite in Arizona. Well-established but light stands of mesquite, exceeding 15 plants per acre, where roots extend out as far as 30 feet from each plant, offer serious competition to grass for soil moisture, cause a reduction in the grass stand, and adversely affect forage yields. This is especially true on drier range areas. Density and yield of the perennial range forage grasses were double that of untreated range within 3 years following the killing of mesquite. Control on light to moderate stands of mesquite is practical with Diesel oil or sodium arsenite. Costs for chemical and labor have averaged about 4 cents per plant. These control costs, even with as many as 100 plants per acre, could generally be liquidated in 9 or 10 years by the increased range-forage and livestock production.

Cattle and Deer

In Utah, a cooperative study, begun in 1947 by the Forest Service, Fish and Wildlife Service, Utah State Fish and Game Department, and Utah State Agricultural College, of the interrelation of game and livestock grazing is yielding some enlightening results. The relative grazing or browsing pressure of cattle and deer on common summer range has been measured on 10 major vegetal types.

Areas heavily grazed by cattle are also heavily used by deer—a fact which creates a serious management problem. One notable exception is the oak-sage type. Although competition is close on slopes less than 25 percent, steeper slopes curtail cattle utilization and such areas are left mainly to the nimbler deer. In general, the steep topography restricts cattle to only 52 percent of the summer range as compared with 92 percent for deer, on the area studied.

The study also emphasizes the need for balancing deer numbers with available forage. Winter deer mortality on a fair-condition

range which was conservatively stocked amounted to 9.5 percent. On severely depleted and heavily overstocked range the loss was 41.6 percent.

Measuring Trends

The 3-year study to develop a method for measuring trend in range condition of national-forest ranges has been completed. It provides a definite measurement of a series of 100-foot permanently located transect lines on which are recorded vegetation, bare soil, erosion pavement, rock, and litter, together with a preliminary classification of current range condition and trend. By periodic future remeasurement of the transect lines which are established in the usable parts of the range, a reasonably reliable estimate can be made of improving or declining forage condition and erosion hazard.

In the spring of 1951 plans were completed and personnel assigned to an intensive study of grazing management on several range units of the Bighorn National Forest. The studies are being conducted in cooperation with the University of Wyoming and interested stockmen.

Forest Influences

That water is a key to national progress has penetrated the public consciousness more completely than ever before. There is now a sounder appreciation of the fact that water troubles are closely associated with the condition and use of the land. Much of this enlarged public understanding has come about through the findings of influences research. Such research, together with the special hydrologic investigations undertaken under the Department of Agriculture's watershed flood control survey program, has expanded our basic knowledge of the principles that govern watershed behavior and has developed for specific areas the close interrelations of soil, plants, and water.

Influences studies at 14 Forest Service research centers are making substantial progress in ferreting out the complex factors that affect the hydrologic characteristics of soils and the yield, behavior, and quality of surface and ground waters. It can now be affirmed that the character and condition of the soil mantle—a product of natural forces and human activities—provide an important clue to the control and conservation of water as it enters the channels of large and small watercourses.

Watershed problems everywhere have the same basic elements, and their solutions require the same basic techniques. Nevertheless, the wide variations in climate, soil, topography, vegetation, and use from region to region call for the adaptation of research methods to specific regional needs. These regional differences are reflected in the variety of problems considered, and the correspondingly varied approaches applied by the several influences research centers.

Evidence of Fire's Effects

A sequence of fire, denudation, and heavy rainfall on two chaparral watersheds in southern California provide further clear-cut evidence of the disastrous consequences of exposing soil. Two days after a 33-acre fire on July 4, 1950, a storm producing about three-fourths

of an inch of rain struck the area. Within half an hour, flows of mud and boulders surged from the watershed. The swift debris flows threatened the lives of returning fire fighters. They caused several thousand dollars damage. Severe soil washing—at the rate of 49,000 cubic yards per square mile in one area—exposed bedrock on the higher slopes. No debris emanated from the adjacent unburned well-vegetated canyons, despite their exposure to the same storm.

Steps must be taken immediately to revegetate such scorched soils if the possibilities of disaster are to be reduced. Tests with 26 different soil stabilizing plants during the past 2 years reveal 2 species that meet this need effectively. Black mustard, which has long been used for the purpose in southern California, rated the best. Sown on freshly burned areas, it has produced stands of satisfactory density on over 70 percent of the area. Annual ryegrass has also proved durable and effective, although it does not spread as well as other plants.

In the Southwest, extensive areas of granitic soils that had once been overgrazed continue to furnish destructive sediments to reservoirs and channels. It was previously thought that long-continued protection from heavy grazing would permit the vegetative cover to improve sufficiently to control excessive erosion. This view has proved overoptimistic. Large areas have still not recovered after 22 years without grazing. Obviously more than this is needed. What kinds of measures will be most effective, and how quickly and cheaply they can be applied, poses a provocative problem for further scientific inquiry.

“Operation Snow Pack”

The abnormally large snow pack on the headwaters of the Columbia in 1950-51 provided an unusual opportunity to measure and observe snow and its runoff under different cover conditions. An “Operation Snow Pack” was organized to capitalize on this situation. Three two-man parties spent 6 weeks in the field systematically studying the relation of plant cover to snow accumulation and melt. Supplies were delivered to isolated parties by parachute, and communication was maintained by short-wave radio. The preliminary findings showed that: Brush had little effect on snow accumulation or melt; heavily forested areas accumulated less snow than open areas, but snow-melt rates were slower under timber than on grass or cut-over areas; more snow tended to accumulate in patchy clumps of timber than on open areas.

Further south in the Rockies, studies were continued on the factors that affect water quality. A major problem here is how to utilize timber and forage on the watersheds and yet maintain or improve the quality of stream flow for water supply and other purposes. The answer lies in keeping the soil out of the streams. Different types of cover vary significantly in their soil-water protective value. The development of a rapid and inexpensive method of determining quantitatively the relationships between cover types and soil-water protection is one of the fruitful byproducts of the investigations during the past year. Forest research workers designed a “Rocky Mountain Infiltrimeter,” a portable device for applying controlled amounts and intensities of rainfall to small plots covered with various types and densities of vegetation, and for measuring the subsequent rates of runoff

and erosion. A similar device has been used to determine the soil-protection needs of the mountain range lands of the Intermountain region in Utah. Analysis of data from such studies indicates that, as a general rule, surface runoff and soil-loss rates can be maintained below the danger point (runoff of less than 5 percent per storm) where at least two-thirds of the ground surface is sheltered by vegetation and its litter.

Flood Sources

In the northeastern United States, where the snowpack is frequently less than 2 feet deep, past flood-control investigations have indicated that soil freezing often has a significant effect on the size of winter and early spring floods. Soil freezing reduces the infiltration of water from melting snow or spring rains. The duration, extent, and type of frost appear directly related to the type, density, and condition of the vegetal cover and soil characteristics. In general, the denser the cover, the less will be the extent of frost and the more porous its character. Intensive field and laboratory studies are under way at six locations in New England, New York, and Pennsylvania to determine these relations more precisely as a basis for predicting the effects of various watershed flood-control measures in this region.

Studies of the effects of uncontrolled logging, fire, grazing, etc., on sensitive mountain terrain indicate that relatively small unstable areas can become sources of excessive flood and sediment damages. For example, in the Shenandoah Mountains of Virginia and West Virginia and other parts of the Southern Appalachian Mountain region, long-continued farm and forest practices have cumulatively lowered the stability of steep mountain slopes to the point where severe soil and rock slides follow the heavier storms, depositing large amounts of debris on valley farms and settlements. Intensive research is needed to develop systematic methods for identifying such potential flood-debris source areas and exempting them from logging, road-building, and other practices which, according to scientific investigations, contribute to their instability.

Other lines of research offer promise in achieving increased water yields. At the Coweeta Experimental Forest in North Carolina sulfur dioxide was employed to defoliate stream-bank vegetation as a means of reducing transpiration to obtain a temporary increase in stream flow.

Assistance on Watershed Problems

Substantial assistance on watershed-management problems was provided during the year to Federal, State, and local agencies. Among these activities was an initial exploration of New York City's watersheds, requested by city officials, resulting in recommendations for the development of policies and practices conducive to increased yields of high-quality water. The Forest Service also participated in water-conservation activities of the cities of Los Angeles and Glendora, Calif., and of the Interstate Commission on the Potomac River Basin. Assistance was given to the President's Water Resources Policy Commission in preparing its reports on national water policy, and to the technical activities of the Hydrologic and Sedimentation Subcommittees of the Federal Inter-Agency River Basin Committee.

Forest Economics

Comprehensive and reliable facts about the Nation's timber resources, the use of timber products by different industries, and future requirements for various forest products are becoming more and more necessary in planning for full-scale timber production and for adequate future timber supplies. The collection and interpretation of these basic facts constitute important phases of the Forest Survey, authorized by the McSweeney-McNary Act of 1928.

During fiscal year 1951 field inventory work for the national survey of forest resources covered about 14 million acres of previously unsurveyed forest lands in California, Idaho, Kentucky, Indiana, New York, Pennsylvania, Maryland, and Tennessee. In addition, about 19 million acres of forest land, initially inventoried in the 1930's in Washington, north Idaho, Minnesota, Wisconsin, Michigan, Arkansas, Georgia, and Florida, were resurveyed to bring the original information up to date. In 14 of these States substantial financial or other assistance was contributed by cooperating public and private agencies. Analytical forest-resource reports for the States of South Carolina and Mississippi were completed, and a report was issued for the Lake States. Statistical reports were issued for Montana, Florida, and parts of Tennessee, Kentucky, Minnesota, Oregon, and California.

Since the Forest Survey was begun in 1930 about two-thirds of the 620 million acres of forest land in continental United States have been covered by initial surveys. About 120 million acres of forest land initially covered prior to 1940 also have been resurveyed.

Surveys of the use of forest products by railroads, in fabricated articles, in shipping agricultural and industrial products, and in farm construction have been under way as a basis for estimating future needs. A survey of wood used in manufacture in 1948, covering 92,000 manufacturing plants in 190 industries, was completed during the year. The results showed that the equivalent of nearly 14 billion board-feet of lumber, veneer, and plywood was used in manufactured products. The greatest amounts were used for containers (34 percent), millwork (16 percent), furniture (16 percent), flooring (8 percent), and construction and repair of railroad cars (3 percent). Six kinds of wood made up about two-thirds of the total volume, including 2.4 billion board-feet of ponderosa pine, 1.8 billion feet of southern yellow pine, 1.4 billion feet of Douglas-fir, 1.3 billion feet of oak, 1.2 billion feet of sweetgum, and 0.7 billion feet of yellow-poplar.

Special Economic Investigations and Reports

Plans of defense agencies for sustaining production of lumber, plywood, wood pulp, and the many other wood products have greatly accentuated needs for information on many strategic timber resources and available supplies and requirements for timber products needed by the military and other essential users. A variety of special investigations made by the Forest Service have resulted, for example, in: (1) Reports for the National Security Resources Board and the President's Materials Policy Commission on production, imports, stocks, and consumption of the various forest products and the probable quantities that will be required in the future to meet demands at assumed levels of general economic activity; (2) reports to the President's Materials Policy Commission on long-range requirements and

supplies of forest products; (3) a report in cooperation with the Economic Commission for Europe on trends in timber production, consumption, and foreign trade of the United States in the most important forest products; and (4) reports on foreign forestry and international trade consisting of appraisals of the adequacy of forest resources and forest industries in foreign countries, especially those of strategic and critical importance, and impacts upon balancing the timber budget of the United States.

Special reports reviewing raw-material supplies, and other production problems were prepared for the National Production Authority to provide background information for passing on prospective loan and tax applications from manufacturers of pulp and paper, lumber, veneer and plywood, wooden pallets, and other products. Reports on supplies and requirements for cork and tannin extract, including an appraisal of possible domestic substitutes to relieve dependency on foreign supplies, also were prepared for defense agencies.

Military use of lumber and other forest products during World War II, military procurement of timber products by the Central Procurement Agency, and an analysis of procurement problems, were the subjects of investigations made by the Forest Service for the Corps of Engineers. These studies indicated that about 70 billion board feet of lumber was consumed for military purposes during the last war, of which 30 percent was used directly by war agencies. The remainder was used by civilian firms and contractors for the construction, fabrication, and shipping of war-contract items. Military lumber consumption amounted to 38 percent of total United States consumption for the war period.

Another national defense project started during the year as a service to the National Production Authority and other defense agencies, involves a survey of equipment, supplies, and manpower used by primary forest-products industries in the several forest regions of the United States as a basis for estimating wartime needs. Industries covered include sawmills, veneer mills, pulpwood operations, pole and piling concentrators, mine-timber supplies, wood-chemical plants, and miscellaneous bolt-using industries.

Studies in the marketing of forest products have included the testing of hardwood log grades developed by the Forest Products Laboratory to determine their applicability for price reporting and the guidance of log buyers and sellers. Timber buyers' directories have been prepared with the object of bringing buyers and sellers of timber and logs closer together.

Forest Products

Research directed toward the more complete and efficient utilization of forest products and the development of new products is centered at the Forest Products Laboratory, maintained by the Forest Service at Madison, Wis. An account of some of the year's activities follows.

Pruning for Clear Lumber

Artificially pruned Douglas-fir trees begin to produce clear lumber in about one-tenth the time required by trees on which the lower branches are left to die and drop off naturally, it was found in pruning investigations conducted by the Laboratory in the Pacific Northwest.

Branch stubs persist as knots for as long as a century in unpruned trees, whereas artificially pruned branches of second-growth trees 30 to 50 years old healed over in about 10 years and from then on clear lumber was formed. The investigation gave no evidence that pruning left wounds that were infected by decay fungi. Fast-growing trees, as would be expected, healed over more rapidly than did slow-growing trees.

Sandwich Design for Aircraft and Guided Missiles

The Laboratory's research concerning the strength of plywood and its successful development of design criteria for this complex material has brought requests from the military services for similar work in the field of sandwich construction. Sandwich construction consists of facings of strong, dense materials separated by weak, light cores. This extremely light and rigid material has found many useful applications, among them aircraft and guided missiles. The Laboratory's investigations have led to design criteria and fabrication data for sandwich construction which have been published by the Armed Forces.

New House-Sheathing Method

A method of sheathing house walls was developed that meets Federal Housing Administration design requirements for stiffness and strength of walls. Sheathing strips nailed diagonally across studding were spaced about 2 feet apart, and vertical siding was nailed directly to them. Wall sections thus built with studs spaced 24 inches on center (conventional practice calls for 16 inches) were tested and found amply strong. In a house with 1,000 square feet of floor area, such spacing of sheathing boards saves 80 percent on sheathing lumber, or about 1,000 board feet. In addition, about 35 pounds of nails are saved, not to mention the added economy of greater stud spacing and possible saving in construction time.

Pulping Mixed Species Practical

Results of a series of pulping experiments with various species in mixture showed that it is not always necessary to segregate species for pulping. Contrary to long-held beliefs of the industry, different species can be pulped together, provided due consideration is given to the pulping characteristics of the individual species, particularly their chemical composition and their density. Good results were obtained in the cold caustic soda pulping of mixtures of some 20 east Texas hardwoods together with some southern pines. Other successful semi-chemical pulping experiments have included runs with nine eastern hardwoods, including cherry, birch, maple, oak, ash, and beech; several white oaks; several hickories; various proportions of jack pine and aspen; and mixtures of tupelo, yellow-poplar, and maple. The tests indicate the feasibility of using woods-run pulpwood without the usual sorting of species.

Lumber Grades for Military Boxes

The most economical grades of five species of lumber widely used for boxes were determined for the Corps of Engineers, Department of the Army. The tests showed that, without exception, the most economical box was made from the lowest grade of lumber, despite

the longer time required to make it and the greater amount of waste in the lower grades. The investigation was based on actual labor costs and fabricating methods at a large military installation. Results of the investigation are expected to be used by the Corps of Engineers in the purchase of box lumber for the Armed Forces.

Low-Cost Veneer Flooring

A method of drying veneer to produce flexible, flat sheets with low shrinking and swelling properties was developed that makes possible a new approach to the problem of using wood finish floors directly on concrete slabs. Such floors are becoming increasingly popular in low-cost basementless houses. The veneer is dried, green from the lathe, in a hot press equipped with special cauls that grip it sufficiently to eliminate virtually all lateral shrinkage during drying. Subsequent swelling and shrinking are also less than for normally dried veneer. The hot platens dry $\frac{1}{8}$ -inch veneer in about 10 minutes, or more rapidly than the conventional veneer dryers. One face of the veneer remains smooth and takes on a natural dull gloss during the drying process so that little if any further finishing is necessary other than conventional floor sealer. Strip flooring of $\frac{1}{8}$ -inch veneer has been laid as an office floor in mastic directly on concrete to determine application characteristics and performance under constant use.

Forest Utilization Service

Established in 1944 and now functioning at 8 of the 11 regional forest experiment stations, the Forest Utilization Service is a connecting link between the Forest Products Laboratory and timber growers and users, including the forest-products industry. The Forest Utilization Service performs an important dual function in the effort to achieve complete and efficient utilization of the forest crop. It analyzes the wood-using problems of the various regions and presents these problems for solution by research; it also brings research results to forest owners, and to the forest-products industries and related interests.

In addition to carrying on most of its normal functions during the past year, the Forest Utilization Service was especially active in field work related to the national-defense activities of the Forest Service.

PERSONNEL

Program activities in the Forest Service are carried on almost entirely by professional employees. Many professions are represented, but, as would be expected, the majority are foresters. Practically all of the professional recruits are appointed from the Civil Service register of eligible candidates for junior forester. It appeared that a more than adequate roster of candidates was available when the 1951 register was established, since more than 1,200 applicants passed the competitive examination in 1950. Since professional forestry schools in the United States conferred 2,321 bachelor degrees, 275 masters degrees, and 29 doctors degrees in 1950, there was a large pool of trained foresters to supply the demand of all other Federal, State, educational, and private employers.

Despite the apparently adequate register of junior forester eligibles, the Forest Service has experienced considerable difficulty in filling its

financed vacancies. Numerous offers of employment were declined, making the recruitment process long and costly. Declinations have been due principally to the fact that eligibles have been able to obtain jobs with other employers who offered beginning salaries higher than the salary rates for comparable work provided in Civil Service Classification Act schedules.

The placement program which has confronted the Forest Service since the end of World War II, and which has resulted in numerous transfers in order to place returning veterans, has been completed, and a normal turn-over situation has been restored. Since the Forest Service is a career service, the normal turn-over among permanent employees is quite low. The Forest Service, however, has lost a number of its experienced foresters and other trained employees who have resigned to accept more lucrative offers from private employers.

Engineers, like foresters, are recruited in the entering professional grade. Industry has absorbed most recent graduates of engineering schools, with offers of salaries in excess of the \$3,100 per annum which is the rate paid Government workers in comparable assignments. As a result, the Forest Service has been unable to employ the full number of junior engineers needed.

Training and Development

Orientation-training camps for newer technical employees were resumed on a wider scale during the past year, after a 2-year period during which lessened recruitment made it impracticable to hold many such camps.

In one region "traveling" training sessions were held for some rangers and national-forest staff personnel, to give more comprehensive on-the-ground training, mostly in resource management, than would be possible in one limited training camp locality.

In cooperation with the Civil Service Commission, tests designed to indicate executive and administrative capacity were given to some 200 administrative and line employees. The test results showed a reasonably close correlation with multiple appraisals of those tested.

Awards

Two members of the Forest Service received the Department of Agriculture's Distinguished Service Award in 1951. The Department's award for superior service was given to 11 Forest Service men and women. These awards were in recognition of exceptionally meritorious service and accomplishment, and, in one case, of courageous action that saved human lives in a forest fire.

The Forest Service awarded meritorious promotions to 39 of its employees in recognition of unusual initiative and accomplishment on the job. Ten employees received cash awards for valuable employee suggestions. Recognition was given to 14 employees who had completed 40 years of service.

Retirements

During the year, 90 Forest Service employees retired for age or by option, with an average Government service of 36.1 years and an average age of 63.2 years. An additional 51 employees retired because of disability, with an average Government service of 18.31 and an average age of 54.5 years.

Foreign Visitors

The Forest Service had a number of foreign visitors during the year who came to the United States for information or training in forestry.

The largest group of visitors included some 40 foreign nationals, from more than 20 countries, who arrived for a 6-week study tour of forest fire control in the United States starting early in September 1951. The tour was sponsored jointly by the Economic Cooperation Administration and the United Nations Food and Agriculture Organization. The Forest Service assumed responsibility for preparation of the agenda and supervision of the study tour which consisted of a demonstration and training course in all phases of fire control.

STATEMENT OF RECEIPTS AND EXPENDITURES

National Forests

Receipts from the national forests deposited to Forest Reserve Fund amounted to \$56,147,342. In addition \$1,266,898 was collected from revested Oregon and California Railroad Co. grant lands and \$146,049 from Tongass National Forest in Alaska, both of which were deposited in suspense pending proper disposition, making a total of \$57,560,289. Of the Forest Reserve Fund receipts, \$51,098,565 was from timber, \$4,165,574 from grazing, and \$883,203 from special land uses, water power, etc. Of the amount credited initially to the Forest Reserve Fund, \$107,294 is returned to Arizona and New Mexico on account of State school lands within national forests; \$138,996 has been appropriated for acquisition of national-forest lands, and \$4,943 is derived from designated lands in the Superior National Forest, for which special payment is made to the State in lieu of the usual 25 percent. Of the remaining \$55,896,109, 25 percent or \$13,974,027 is paid to States for the benefit of public schools and public roads of the counties in which national forests are situated (subject to possible deduction of not more than \$233,333 to meet the matching requirements of the Cooperative Range Improvement Appropriation); also 10 percent of the same base amount and of the \$4,943, or \$5,590,105, is appropriated to the Forest Service for roads and trails within national forests. From the remaining balance there is appropriated \$44,810 for payment to Minnesota on account of the designated area in the Superior National Forest and \$700,000 from grazing receipts of various national forests for range improvements on such forests.

Expenditures for national-forest operation, protection, and management were \$38,518,573. Additional expenditures from appropriations for forest roads and trails amounted to \$16,047,533 and for acquisition of national-forest land \$389,384.

Aid to States

Forest Service expenditures for cooperation with States and private agencies in fire control, planting, and assistance in forest practice were \$10,634,618.

Research and Miscellaneous

Expenditures for forest research were \$5,089,420; for flood control \$1,680,751; general administrative expense \$648,728.

A total of \$5,891,388 was also expended for fire control, slash disposal, improvement work, timber-stand improvement, and other work financed by outside agencies and from receipts authorized to be expended for specified purposes.

Services for other Government agencies from funds advanced or transferred by such agencies amounted to \$1,470,646, including \$130,233 for the Department of the Interior, \$608,378 for the Army, \$158,952 for the Navy, \$140,499 for the Housing and Home Finance Agency, \$122,673 for the Production and Marketing Administration (Agriculture), \$164,326 for Defense Production (Executive Office of the President), and \$145,585 for other agencies.

Total net expenditures were \$80,371,041. In addition, expenditures for which appropriations were reimbursed amounted to \$4,950,835 and expenditures from proceeds of sale of parts and equipment purchased in prior years \$449,225. Expenditures were accounted for by objective and functional classifications under 116 separate appropriation titles.

The Forest Service handled the naval stores conservation program, involving payment of \$408,738 from funds of the Production and Marketing Administration.

REPORT OF THE CHIEF
OF
THE FOREST SERVICE
1952



AMERICA'S STAKE
IN WORLD FORESTRY



UNITED STATES DEPARTMENT OF AGRICULTURE

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., September 15, 1952.

HON. CHARLES F. BRANNAN,
Secretary of Agriculture.

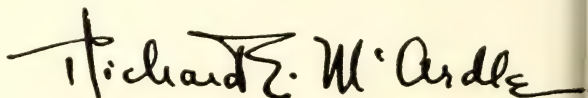
DEAR MR. SECRETARY: In addition to reviewing the work and accomplishments of the Forest Service during the past year, this report discusses some problems of world forestry. Adequate forest resources and their proper utilization are key factors in the economy and living standards of a free world. In forestry, as on many other fronts the United States is providing technical assistance and other aids to the extent of its ability. This report therefore attempts to highlight the world forest situation, our stake in world forestry, and foreign forestry activities of this country.

My predecessor as Chief of the Forest Service, Lyle F. Watts, retired from active duty on June 30, 1952. The activities reviewed in this report occurred largely while he was still in active service and the accomplishments reported were achieved under his direction.

As the culmination of a career of nearly 40 years in Government forestry work, Mr. Watts served more than 9 years as Chief of the Forest Service. Under his leadership the Forest Service made notable progress in the program for development of the national forests, in its research programs of forest and range management and wood utilization, and in its cooperative work with the States to aid and encourage the protection and management of forest lands. During this period the whole forest conservation movement advanced substantially.

The Nation's policy for forestry aims at making and keeping our forest lands fully productive, in the interest of national security and welfare. As the new Chief of the Forest Service, I shall continue to work for that objective.

Sincerely,



RICHARD E. MCARDLE,
Chief, Forest Service.

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AMERICA'S STAKE IN WORLD FORESTRY

A growing world population is making ever-increasing demands on the world's natural resources. As the peoples of various nations attain higher standards of living, they will call for greater quantities and varieties of material things. Their multiplying demands for the world's goods will further increase the drain on basic resources.

Important among the basic resources are those of the forests. Along with the tree-growing areas, we should also consider the range lands—the native grasslands and other areas of natural vegetation. Forests and range lands comprise a major portion of the world's total land surface. Their condition affects the welfare of millions of human beings.

Forests furnish the raw material of thousands of useful or essential commodities. They have scenic and esthetic values that are the basis of huge investments in tourist and recreational enterprises. Many forest and natural range areas furnish forage for the production of livestock and the support of wildlife. Forest and other natural vegetation areas feed the world's great rivers; they are the source of much of the world's supply of fresh water, upon which industry and agriculture—and human life itself—depend.

How the forests—not only those of our own country but those of other parts of the world—are handled, whether their productivity is maintained or improved, is therefore a matter of concern to us. Resources of the forests are among the things that contribute to the strength and security of the free world. They may help to determine whether we survive against the forces that threaten us.

THE WORLD'S TIMBER SUPPLIES

Forest and range resources, fortunately, are renewable resources. As timber is used, as forage is consumed, more can be grown from the same land—that is, if the land is not made useless by destructive exploitation and erosion.

Some 10 billion acres, about one-fourth of the world's land area, is forest land. About one-third of this forest land has only sparse and scattered stands of small scrubby trees, the kind of tree growth found in alpine locations, in desert and semiarid areas, and in arctic regions. In the United States, we call such forests noncommercial forests. They are often of great value for watershed protection, they may be useful as sources of fuel and of wood for handicraft and other local uses, but they contribute little to the world's supply of industrial wood. This leaves about 6½ billion acres of forest land that can be classed as productive or potentially productive, capable of producing commercial crops of timber. Nearly half of the area of these productive forests remains inaccessible, including substantial portions of the great forest areas of Canada, South America, Africa, southeast Asia, and Oceania. Even in the United States many million acres of productive

forest land are still unavailable as a source of timber products because of lack of transportation facilities.

So some 3.6 billion acres, about 35 percent of the world's total forest area, is at present both productive and accessible. About one-fourth of this is in Soviet Russia and other countries behind the Iron Curtain, and so at present largely unavailable to the free world.

The large areas of productive forest now inaccessible are, of course, a potential resource that may eventually contribute substantially to the world's timber supplies. But it may be a long time before the development of many of these forests in remote and rugged parts of the earth becomes economically feasible. More timber products from the Soviet sphere also may some day enter into world trade. But Russia's own growing needs will probably limit the volume of timber products available for export. For the foreseeable future the free world must depend mainly on what timber supplies are available, and what can be grown, on its own productive and accessible forest lands.

Softwoods and hardwoods

About 70 percent of the world's forest land is in the Northern Hemisphere. In the temperate regions of the Northern Hemisphere, moreover, is found practically all of the coniferous or softwood timber. Softwoods, such as the pines, firs, and spruces, are the woods most commonly used by our principal forest industries. They provide the bulk of our construction lumber; they are the source of most pulp and paper products.

The north temperate forests also contain a variety of general-utility hardwoods—oaks, maples, gums, and other broadleaved trees. The woods from various of these hardwood species find many uses—for flooring and certain other construction needs, for cooperage, veneers, furniture, tools, implements, and many other commodities. Some of the hardwoods of the temperate regions also are being used to an increasing extent for pulp and paper.

The Southern Hemisphere contains very little softwood or temperate hardwood forest. The main forests of South America, of Africa, of southeastern Asia, and of Oceania lie almost wholly in the tropics and are composed largely of tropical hardwood species.

The tropical hardwoods that have found a place in industry and trade are mainly those possessing characteristics that make them suitable for cabinet work and specialty uses. Mahogany is a choice cabinet wood, and it also has important military uses for boat and aircraft construction. Balsa has been in demand for life rafts and preservers, for aircraft plywood, and other specialty uses requiring extreme lightness and buoyancy. Teak is one of the finest woods for ship decking and planking. Lignum vitae is used for propeller-shaft bearings.

Hundreds of other kinds of woods, growing in mixture throughout vast areas of tropical forest, have as yet no established commercial value. Their properties are largely unknown, their potential uses undetermined. Unless and until profitable markets can be found for the great variety of little-known tropical hardwoods, these abundant woods will contribute little toward meeting the world's timber requirements.

Forests and Living Standards

An abundance of wood and bountiful supplies of water (also to a large extent a forest product) are among the things that contribute to a country's industrial development and high standards of living. In contrast, destruction of forests and deterioration of watershed values have helped to create acute economic problems in many parts of the world. Wood and water scarcities are reflected in low living standards for millions of people.

A crying need in many parts of Asia, the Near East, and north Africa is for the protective influence of forests on watershed lands. Except along some of the river bottoms, the land is so denuded and eroded that agricultural use is practically impossible.

Many an American burns as much wood in his living-room fireplace during a few winter evenings as the average person in north Africa or the Near East uses for all purposes, including fuel, during a whole year. Because of wood scarcity in many of the densely populated parts of the world, especially Asia, the people must rely largely on such material as grasses, shrubs, or cattle dung for fuel.

We in the United States consume two-thirds of the free world's total yearly output of wood pulp. We use about half of all the lumber. Our per capita consumption of wood for all uses is more than three times the average of the free world, as reported by the United Nations' Food and Agriculture Organization. With fuel wood excluded, it is nearly five times the world average. In Europe and Asia, more than half of all wood consumed is burned for fuel; in South America and in Africa, more than 80 percent, whereas in the United States only about 11 percent of our wood consumption is for fuel. For industrial uses (fuel wood excluded) only one country, Canada, consumes more wood per capita than does the United States.

The World's Needs Will Increase

The chief wood-using countries of the free world—Canada, the United States, and the countries of Western Europe—now consume more than 80 percent of all the wood used. Undoubtedly they would use even more if plentiful supplies were available at moderate cost. There is an enormous potential demand in many wood-hungry countries of Asia, Africa, and Latin America. The needs of these countries for timber products are bound to grow as populations increase, economic conditions improve, and living standards rise.

What are the possibilities of the free world meeting its future needs for wood?

In the report of the President's Materials Policy Commission last year, it was estimated that the prospective annual requirements of the free world for industrial wood some 25 years hence would be about 40 percent above the 1947-49 consumption average. But against this prospective increase in requirements, the estimated increase in the free world's annual output of industrial wood is only 4 percent, unless extraordinary measures are taken to build up forest productivity in the more advanced countries and to expand production in underdeveloped countries.

The Western European countries generally are much more advanced than other parts of the world in the application of forest management designed to maintain the forests in permanently productive condition. In the United States and Canada, such management methods are not as yet widely enough practiced to assure perpetuation of the resource at a level commensurate with probable future national requirements. In Africa and in Latin America, forest management, with a few noteworthy exceptions, is either lacking or just beginning. A high order of forest management can be found in the teak forests of Burma, Thailand, and Java and in some parts of India, Malaya, Australia, and New Zealand, but in most of Asia and Oceania the forest conditions reflect a lack of systematic care and protection.

Canada may eventually increase output

Canada, now the world's leading exporter of timber products, has large areas of unexploited forests, predominantly softwoods. But these include millions of acres of trees of small size and slow growth, in the northern part of the country. Less than two-thirds of Canada's total forest area is classed as commercially productive, and of the productive forest area about one-third is at present inaccessible.

Canada has by no means attained the maximum sustained output of forest products of which its forest lands are capable. Losses from fire, insects, and disease have been heavy, and many areas have been cut over without adequate provision for restocking. With wider application and intensification of systematic forest protection and management, it should be possible to increase the harvest of wood from the forest areas now accessible. Also, large areas now classed as inaccessible will eventually be opened up. In the long run, therefore, Canada should be able to increase her output of forest products, on a sustaining basis.

But with Canada's industrial expansion and increasing population, her own needs for timber products are growing. And so are those of other nations with which Canada may wish to maintain trade relations. The United States cannot safely look to Canada for imports of forest products greatly above present levels, particularly of saw-timber products.

Western Europe's forests

The area of the productive forests of Free Europe represents only 5 percent of the free world total, but includes nearly 30 percent of its northern softwood forest area. These European forests are almost all accessible. Many of them have a longer history of management and regulated yield than those of any other world area.

Prior to World War II, annual cutting in the forests of Western Europe was generally in approximate balance with annual growth. There was serious overcutting, however, in some of these forests during and after the war years. Although definite data are lacking, it is generally believed that regional drain still exceeds growth by a considerable margin.

Western Europe, before the war, obtained a substantial part of its forest products import requirements from the U. S. S. R. and from other Eastern European countries now behind the Iron Curtain. During and immediately following the war, these imports were almost wholly cut off. They are still far below the prewar volume.

If improvement in Western Europe's over-all economy continues, the demand for timber products may be expected to rise to or above pre-war levels. But there is little possibility that the countries of Western Europe will be able to increase very greatly the output from their own forests without suffering the consequences of prolonged over-cutting. The gap between their timber needs and actual production will probably widen, and it will be a gap that cannot be filled from Western Europe's forests alone. Generally, Europe's forests need rebuilding, rather than heavier cutting.

If, before many more years go by, there should again be a free flow of trade and the countries in the Soviet orbit should participate fully in meeting world timber demands, the European timber-supply outlook would improve materially. With one-fourth of the world's productive forest land, and nearly half of its softwood-forest area, the U. S. S. R. might again become the world's leading softwood-timber exporter. Its forests probably can be developed eventually to sustain an output two or three times greater than at present. But the timber requirements of the Soviet bloc are growing steadily, and that area may continue to consume internally a very large percentage of its current production.

Latin America's undeveloped forest resources

Latin America's total area of productive forests is about 75 percent greater than that of the United States and Canada combined. It includes vast stretches of undeveloped "jungle" in the more remote areas.

Few of the Latin-American countries have effective forest-conservation laws or adequate forestry services or schools. Forest management is in the beginning stages.

In many of the hardwood areas, only a few of the choicest species have been cut in commercial logging operations. This has reduced the supply of such choice woods as mahogany and Spanish cedar (cedro) in the most convenient locations, causing deterioration in the value of the culled stands.

Outright forest destruction more often results from cutting for fuel wood, which is estimated to comprise some 80 percent of total wood consumption in Latin America, and from a shifting or roving type of agriculture. This system of primitive farming, based on using the comparatively fertile virgin forest soils, is practiced widely in the tropics. The farmer clears a patch of forest, grows food crops for a few years, until the land wears out, then clears a new patch of forest and abandons the old clearing. Serious erosion in many places on the steeper slopes results from this "milpa" system of agriculture.

The only sizable body of natural softwood timber in Latin America is in the Parana "pine" region of southern Brazil, with a small extension into Argentina (Parana pine is not a true pine but an *Araucaria*).

In addition to the Parana pine belt in Brazil, there are softwood forests in Mexico, Central America, and Chile. None of the softwood forest areas of Latin America is large enough to permit substantial timber exports without overcutting or ignoring future domestic needs.

The vast unexploited forests of such regions as the upper Amazon and upper Orinoco contain a great variety of hardwoods, many of

which may have commercial possibilities. But, aside from pulp and paper and other products of the wood-chemical industries, there is considerable doubt as to the extent to which tropical hardwoods can be economically substituted for the northern softwoods and hardwoods that now supply the great bulk of the free world's industrial wood requirements.

Central and South Africa

The total forest area of Central and South Africa is greater than that of Latin America, but only about 40 percent of it is classed as productive. Large areas of these forests are inaccessible at the present time. A zone of tropical-rain forests exists near the equator, containing hundreds of tree species, all of them hardwoods. The mountain forests in eastern Africa and in the eastern part of the Union of South Africa are also predominantly hardwoods. North and south of the equatorial-rain forests are deciduous forests in which fewer species occur and the stands are less dense. The next zones are open tree savannahs, beyond which lie zones of shrub and thorny savannahs, and finally the deserts and steppes of the extreme northern and southwestern parts of the continent.

Great areas of Africa's original forest have been destroyed by overgrazing or by shifting cultivation, involving the annual clearing and burning of patches of forest. The process is continuing. In the past, when native populations were small, the practice of shifting cultivation probably did relatively little damage because the periods between crops were long and the forests and soils had a chance to recover. Increases in population during the past half century, resulting from improved sanitation and the virtual elimination of tribal warfare, have speeded the processes of deforestation and forest deterioration.

As in Latin America, logging in Africa has been limited to a few species of established commercial value. Most of the rain-forest species are still commercially unknown.

The region is now a small net exporter; hardwood log and lumber exports have increased since the war. But Africa itself has one of the world's lowest wood-consumption rates; its per capita consumption is only about one-half of the world average, and something like 90 percent of that is for fuel.

To raise the level of the present population's wood consumption to the world average would require a doubling of supply. Increasing population and economic development actually are causing an expanding domestic demand for wood, and there is little prospect of the region becoming a major exporter of forest products.

Timber deficit in North Africa and Near East

North Africa and the Near East are the most timber-deficient areas in the world. Forests cover only 4 percent of the region's area, and less than one-quarter of these forests are both productive and accessible. Throughout the region, ancient abuses of the land and its vegetative cover, continued and accentuated in modern times, have reduced once extensive forests to scrubby remnants. Excessive grazing by roving herds, uncontrolled cutting for fuel wood, and widespread fires have combined to make this region's forest resources poorer than those of any other. The denudation of watersheds has resulted in

uncontrolled runoff of water, floods, erosion, and inadequate water supplies.

Limited areas of mountain forest of good quality are found in portions of Iran and Turkey. Some progress has been made in improving remaining forests and in planting new ones elsewhere in the region. But only an intensive program of forest rehabilitation and soil conservation carried on for many years can bring any major betterment of the forest situation. For many years to come, any substantial increase in wood demand, such as would come with expanded economic activity and improved living standards, can be met only through increased imports from other regions.

Surpluses and deficiencies in Southeast Asia

In Southeast Asia, dense tropical rain forests comprise a large portion of the total productive forest area. Coniferous (softwood) forests, confined chiefly to the slopes of the Himalayas and parts of the Philippines, cover about 5 percent of the total area. Burma, Indo-China, Java, and Thailand are the principal suppliers of teak, one of the world's most valued hardwoods. Most of the forests of the region are made up of a great variety of species, only a few of which have present commercial value.

Exploitation of the forests throughout much of the region is difficult because of steep mountains, much swampy terrain, and torrential streams. About half of the forest area is considered accessible. While a large part has not been exploited, the most accessible forests of almost all of the countries have suffered in some degree from overcutting, shifting agriculture, repeated burning, and heavy grazing. In India and Pakistan, the pressure for cropland and for fuel wood has denuded great areas.

The region as a whole has the forest resources to meet its needs for timber without overcutting. But there is no effective way at present to draw on the surplus areas to meet the requirements of the deficit areas. Eventually, the opening up of areas now inaccessible, improvement of transportation facilities, and construction of timber-processing plants should overcome this difficulty. In all probability, however, industrial development and expansion of timber production in the region will come very gradually.

Oceania's forests

The combined productive forest area of Oceania, including Australia, New Zealand, eastern New Guinea, and the islands of the South Pacific, is about 3 percent of the free world's total. Of Oceania's productive forest area, Australia has about 40 percent and New Zealand 4 percent.

Australia's productive forest area is confined to a narrow fringe along part of the coast line. Most of it is in hardwoods, chiefly eucalyptus, of which there are several hundred species. To supplement the limited supply of indigenous softwoods, Australia has planted large areas to exotic conifers, principally Monterey pine, a tree native to California, which has been found to thrive "Down Under."

In New Zealand, about 40 percent of the forest area is now considered accessible. Most of the accessible area is in softwoods; almost half of it has been planted in exotic conifers, chiefly Monterey pine. The inaccessible forests are mostly hardwoods. Increasing demand

for the conversion of forest land to farms and sheep ranches poses a problem in land use. Although Australia and New Zealand export some specialty woods, both are currently net importers of wood products. Neither country can be expected to become an exporter of any substantial quantities of timber to other regions of the world.

About two-thirds of eastern New Guinea is covered with tropical forests, some of which contain softwoods. The opening up of these forests may eventually provide important quantities of wood for Australia's use and for export to other regions. The Fiji Islands, the Solomons, and New Caledonia have a few million acres of productive forest, largely tropical hardwoods.

Critical situation in Japan

Japan has one of the most critical forest resource situations. Although productive forests, including both hardwoods and softwoods, cover nearly 60 percent of its land area, Japan is a timber-deficient country. The heavy demand resulting from rapid industrialization and growth of population has led to severe overcutting. Drain on the softwood forests is now about three times greater than the annual growth. Reforestation has not kept pace with cutting operations, and millions of acres of cut-over land need restocking. Only the national forests, which consist mainly of hardwoods in the less accessible portions of the islands, are generally in good condition and managed according to conservation principles.

If Japan is to gain self-sufficiency in timber, drastic measures to build up the forests to a higher level of productiveness, and intensive forest management to maintain that productiveness, will be necessary. The Japanese Diet in 1951 enacted stringent forestry legislation which, if effectively carried out, should result eventually in a greatly improved forest-resource situation.

OUR TRADE IN FOREST PRODUCTS

Although the United States carries on a fairly substantial trade with foreign countries in forest products, this trade, with the exception of newsprint paper and to a much lesser extent wood pulp and softwood lumber, is not vitally important to our timber economy. Our imports of lumber and primary wood products in relation to our total consumption are small. Our exports are even smaller. With the exceptions noted and aside from comparatively small quantities of cabinet and specialty woods from the tropics, the United States is still essentially self-sufficient.

Softwood lumber, hardwood lumber, wood pulp, and newsprint paper are the four principal forest products moving in international trade. The United States is the world's largest producer of softwood lumber (53 percent of the free world total in 1949), and of hardwood lumber (44 percent of the total). The United States also leads in production of wood pulp (43 percent of the free world total). But the United States is nevertheless a net importer of all of these products. Except for hardwood lumber, it is the world's largest net importer of each. It is also the world's largest importer of newsprint.

Lumber

In 1928 the United States sold 3.2 billion board feet of lumber to other countries. In 1950 our exports had dropped to about half a billion (517 million) board feet. Twenty years ago our lumber exports were about 9 percent of our total production; in 1950 they were about 1.4 percent.

Our imports of lumber, on the other hand, never exceeded 2.0 billion board feet in any one year until 1950, when they reached an all-time high of 3.4 billion feet. This was equivalent to about 8 percent of total United States consumption.

Softwood lumber, from such species as Douglas-fir, spruce, pine, and hemlock, amounts to about 85 percent of our total lumber imports. It includes lumber for construction, for boxing and crating, and other general purposes. Nearly all of it comes from Canada. Our hardwood lumber imports include general-utility woods such as beech, birch, and maple from Canada, and cabinet and specialty woods from the tropics.

Our exports of softwood lumber greatly exceed those of hardwood. Douglas-fir and southern pine outrank all other kinds of softwood. Oak is the principal hardwood exported. American forests contain a number of other hardwoods with properties that make them especially suitable for certain exacting uses. Examples are hickory for tool handles, picker sticks (for looms), and shunt poles (used by the British railroads); white ash for tool handles, boat oars, and athletic equipment; dogwood and persimmon for shuttles; black walnut for gunstocks; and yellow birch for aircraft veneer. These woods have been in demand by foreign countries, but the domestic supply of a number of these specialty hardwoods is becoming increasingly limited.

Our ability to continue substantial imports of softwood lumber probably will depend largely on Canada's future production, the demands of her other customers, and her own growing needs. In the long run, Canada offers less promise as a lumber exporter than as a supplier of pulp and paper. Her area of forest land suitable for saw-timber production is relatively small, compared with that of the United States. Much of Canada's forest area is too far north to produce trees of the larger sizes.

Pulp and paper

In 1950 the United States imported 1.8 million cords of pulpwood from Canada. This was 7.8 percent of our total pulpwood consumption.

United States imports of wood pulp (2.4 million tons) amounted to 1 percent of total domestic consumption. Canada was the source of about 70 percent of our pulp imports; Sweden, Finland, and Norway supplied most of the remainder.

Our imports of paper and paperboard amounted to about 5 million tons in 1950. Practically all of it was newsprint. For newsprint paper we depend upon importing more than 80 percent of our total supply. Most of it comes from Canada.

Our yearly exports of pulpwood and wood pulp and of paper and paperboard amount to only a small fraction of our imports.

Other forest products

Mahogany, balsa, and teak are among the most important tropical woods imported by the United States. Other specialty woods, imported on a small scale, include lignum vitae, Australian ironbark (used for ship-prow sheathing), and boxwood (for scales and rulers).

We import some softwood logs from Canada (about 156 million board feet in 1950) to be made into lumber or veneer in this country. For the woods used to produce fine cabinet veneers, log imports exceed sawn-lumber imports. The principal sources are the Central American countries, West Africa, and the Philippines.

In the past few years we have imported an average of about 300,000 poles a year, or approximately 4 percent of domestic production. Other imports include several million Christmas trees shipped into this country each year from Canada.

A number of other primary wood products, such as hewn railroad ties, pit props, shingle bolts, and various other kinds of bolts, move in trade with other countries, but as a rule the quantities involved are very small.

Canada world's greatest supplier

The Dominion of Canada not only supplies the bulk of United States imports of forest products, but it is the leading source of timber-products imports for the rest of the free world. In newsprint paper, Canada accounts for 63 percent of the free world's production and 80 percent of its exports. It is also the largest exporter of softwood lumber and wood pulp. In hardwood-lumber exports, Canada ranks second.

Free Europe is a net importer of softwood and hardwood lumber, but it is a small net exporter of wood pulp and newsprint paper. Formerly, Western Europe obtained substantial quantities of forest products from the U. S. S. R. and other countries now behind the iron curtain. When this flow was greatly reduced in the years following World War II, the timber-deficit countries of Western Europe turned to North America as a source of forest products, especially softwood lumber. Dollar shortages, however, limited their purchases. The resultant shortage of wood has been one of the factors hampering postwar reconstruction in Europe. Although timber exports from the Soviet bloc to free Europe have been on the increase since 1948 they are still much below prewar levels.

In the pattern of international trade, then, Canada is the world's great source of forest-products exports. Free Europe's output is largely absorbed in meeting its own requirements. The rest of the free world, including the United States, is largely on a net importing basis for forest products, except for some of the tropical countries which have small export balances in hardwood lumber.

FREE WORLD OPPORTUNITIES AND NEEDS

The foregoing review of the more important aspects of the free world's forest situation and trade in forest products points to the need for greater efforts to build up the productivity and annual wood output of forest lands to meet increasingly greater future requirements for raw wood material. Especially urgent is the need to enlarge the free world's softwood forest growing stocks—to provide larger quantities

ties of such general-utility products as construction lumber and plywood, boxing and crating material, and pulpwood and pit props.

The free world contains 73 percent of the entire world's productive forest area. These forest lands are potentially capable of supplying its total wood requirements. One of the things most needed to improve the future supply situation for timber products is better forest management on forest land now used for timber production purposes. Another is the reforestation of understocked and deforested lands and the afforestation of wastelands adapted to growing tree crops. Still another is the opening up of undeveloped resources and the expansion of timber operations in industrially underdeveloped countries.

Opportunities for increasing the world's supply of timber products lie in the tropical forests of Latin America, Africa, Southeast Asia, and the western Pacific. But any increases in timber output in these areas will be almost entirely of hardwoods, most of them unlike the hardwoods of the temperate forests, and many of them without present commercial uses.

Many obstacles must be surmounted if the countries of the tropical regions are to increase the output of timber products from their hardwood forests. Remoteness and jungle conditions mean problems of health and sanitation for working crews, and high transportation costs in moving the material to markets. And there are at present adequate market outlets for only a few choice species. Unstable governments in some of the countries in the tropical forest regions, and frequently inadequate or uncertain administration of public laws and regulations, add to the difficulties.

Before forest resource development in the more remote tropical areas can be undertaken on a large scale, extensive forest surveys and cruises will be required. A great deal of research will be needed, not only to determine the properties and potential uses of many tropical woods, but to find the best methods of harvesting and transporting the products of these forests and of managing the forests to assure their regeneration and the maintenance of adequate growing stocks for the future.

The Need for Improving Range Lands

There are opportunities, too, in many parts of the world to increase the productivity of the range lands. Range lands, wild grasslands, native forage-producing lands occupy more than half the earth's entire surface. These include grassland areas that are too steep, rough, or rocky, or too dry to be used for cultivated crops. They include open forests and savannas with scattered tree growth, where much grazable vegetation also occurs. They include large areas in desert shrub, mountain meadows, and alpine grasslands near or above timber line. They include the tundras of the far north.

Millions of people, nomadic herdsman and others, gain a livelihood from these lands. Many more millions depend for their living on processing, transporting, or selling the products of the range. From these lands comes a substantial portion of the world's supply of meat, wool, hides, milk, and other animal products. In the United States, approximately half the beef cattle and 75 percent of the sheep get a considerable part of their feed requirements from the more than 950

million acres of natural range lands, which constitute nearly 50 percent of the country's total land surface.

Many of the world's range lands have been long and sorely abused and neglected. Centuries of heavy grazing have killed off the vegetation over large areas, laying bare the soil surface to wind and water erosion that has carried away the fertility of the land. In other places, continued heavy grazing has caused the better forage plants to give way to unpalatable plants. Vast areas of range land are now dominated by vegetation that is of little or no value for grazing. Lack of protective soil cover, resulting from excessive grazing, has caused desert conditions in some areas that otherwise would not be desert.

Only in a few countries—the United States, some of the nations of Western Europe, Australia, New Zealand, and a few others—has attention been given to the management of native grasslands. And in most of these countries, including the United States, positive efforts to improve run-down range have been applied to only a portion of the lands needing it.

Yet the possibilities for increasing the productivity and usefulness of the world's range lands are enormous. With careful management and wise use, productive range can be kept in good condition, and deteriorated range can be improved. Within recent years, range management has been developed as a science, with scientific principles evolved for the handling of range land and the management of livestock grazing on native forage.

In many parts of the world, the grasslands offer the greatest possibilities for increased production of food. Improvement in their productivity could mean raising dietary levels for hundreds of millions of people for whom meat and milk are now rare items. It could help greatly toward meeting the food-production problems that will come with the pressure of an ever-increasing world population.

In any broad effort or program aimed at expanding the world's production and improving the living standards of its peoples, attention should be given to the conservation and wise use of range lands. These lands have potentialities for much greater production, and so for much greater contribution to human welfare.

COOPERATION WITH OTHER NATIONS

Many of the countries with underdeveloped forest or range resources need technical and economic aid from other countries. Such aids can benefit both the people receiving it and those supplying it. Standards of living can be raised in the industrially underdeveloped countries, and increased exports can be provided for other free world areas dependent in part on imports.

The present shortage of technically trained persons in the underdeveloped countries prompts them to turn to other countries for assistance. But in the longer view it will be preferable for the underdeveloped countries to train competent technicians from among their own people to supervise the development of their own resources.

Economic and forest-resource surveys will be needed in the undeveloped forest regions, to guide the formulation of plans for orderly development. Forestry schools and experiment stations will also be

needed. Competent and efficient public forestry services should be built up.

The United States can give assistance in all these things. We can continue to offer training to foreign students in American forestry schools and through other agencies, both public and private. We can help other countries develop their own forestry training facilities. We can also cooperate in experimental projects, and in the establishment of experiment stations and forest-products laboratories.

We have already been doing quite a bit in the way of cooperation with other nations along these lines. We should do much more.

A World Forestry Movement

In 1945, an international Food and Agriculture Organization was formed as a specialized branch of the United Nations. Within FAO, a Forestry Division was set up to serve as a world clearing house of information, to provide a center of international forestry activities, and to help governments coordinate their efforts in order that the products of the world's forests may satisfy the world's needs.

The Forestry Division, with Marcel Leloup of France as its first Director, had its headquarters in Washington, D. C., until 1951, when it moved with other divisions of FAO to Rome, Italy. Regional forestry offices have been established in Geneva, Switzerland; Rio de Janeiro, Brazil; and Bangkok, Thailand.

In the few years since it was established, this international forestry organization already has taken significant action in a number of ways to promote the sound management of forests throughout the world. It has brought foresters from various countries together for profitable exchange of information and discussion of problems. It has assumed the task of gathering world statistics on forests and international trade in forest products. (FAO statistics are the basis of much of the information on world forest resources in this report.)

In its program of technical assistance, the Forestry Division of FAO has sent technical experts, individually or in teams, to help many member countries work out practical methods for improving the management of their forest resources, and for developing their forest industries.

Principles of forest policy

At the regular session of the FAO Conference in Rome, in December 1951, FAO adopted a statement of principles of forest policy to be recommended to all member nations. The recommendation would have each country base its activities in forest management and utilization on a national forestry policy founded on these fundamental principles.

This statement of principles declared that the forest is a factor of prime importance in the economic, social, and physical balance of the world, and that it is essential that each country should formulate a sound forest policy in seeking to perpetuate for the greatest number of its people the maximum benefits from the protective, productive, and accessory values of its forests. As the basis of a sound forest policy, the statement recommended:

That each country should determine and set aside areas to be dedicated for forests, in accord with the country's economic and social pol-

icy, and taking into account the close interdependence of all forms of land use.

That each country should apply the best practicable techniques, including (1) protection for the forest against damage or destruction by man or by natural enemies such as fire, insects, and tree diseases; (2) organization of production to obtain a sustained yield, taking into account the multiple services of protection, recreation, wildlife habitat, etc., that the forest may be called upon to render; and (3) encouragement of economic and rational methods of forest exploitation and of conversion and utilization of forest products for a maximum volume and variety of commodities.

That research should be organized and expanded looking to increased knowledge of all aspects of forest resources, forestry, and the utilization of forest products; and application of research results should be encouraged.

That public consciousness of forest values should be developed by all means possible.

Few countries have adopted such a comprehensive policy. Even the United States, in which the conservation movement has made notable progress during the past half century, falls short in some respects.

American Participation

From the beginning, the United States has cooperated with FAO in its forestry program. American interest in international cooperation in forestry, indeed, goes back many years before the establishment of FAO. As early as 1909, the United States called a North American Conservation Conference. In that same year, the President recommended in a message to Congress that this country invite other nations to a world-wide conference on natural resources, as one of the ways of working for a permanent peace. Although this early proposal never was acted upon, the United States, four decades later, did serve as host to an Inter-American Conference on the Conservation of Renewable Natural Resources (1948), and to the United Nations Scientific Conference on the Conservation and Utilization of Resources (1949).

For many years, American foresters have participated in the International Union of Forest Research Organizations, and in the International Association of Wood Anatomists. An American delegation attended the First World Forestry Congress, held in Rome in 1926 under sponsorship of the International Institute of Agriculture, a part of the League of Nations. Also the Second World Forestry Congress at Budapest in 1936. An American forester was a copresident of the Third World Forestry Congress, held in Helsinki, Finland, in 1949. The official United States delegation to this meeting included representatives of governmental, industrial, and educational agencies.

Each of these meetings has helped to further world forestry. Their recommendations have resulted in a number of actions looking to standardization of procedures in trade, international cooperation in research, and the advancement of technical education in forestry. The meetings provided the stimulus that comes from the direct interchange of ideas and sharing of problems. They afforded opportunities for public and private foresters and forest-products specialists, industrial engineers, forestry educators, and scientists working in related

fields throughout the world to meet and discuss technical matters and problems of mutual interest. It is to be hoped, too, that they have contributed, in some measure at least, to better teamwork among nations. Forestry can be one of the interests that works for international friendship and cooperation.

American foresters had a prominent part in bringing forestry into FAO's program. The late Henry S. Graves, dean emeritus of Yale University's school of forestry, was chairman of the Technical Committee on Forestry and Primary Forest Products, appointed to recommend ways and means for including forestry in the work of the United Nations. This committee, composed of representatives of ten nations, defined objectives and suggested the structure of a permanent international forestry organization. When the Forestry Division of FAO was set up, Lyle F. Watts, then Chief of the United States Forest Service, served as chairman of its standing advisory committee. Several American foresters, including former members of the Forest Service, have served or are now serving on FAO's headquarters staff, or have joined its technical-assistance missions to member countries.

Technical assistance

The Forest Service also has furnished specialists for technical-aid missions to a number of countries, at the direct request of each country to the United States Government.

Forest Service specialists have conducted or participated in forest resource studies, in cooperation with local authorities, in Chile, Ecuador, Costa Rica, and Panama. The Forest Service made available several technical employees to assist in organizing the forestry phases of the military occupations in Japan and Korea; and since the end of the occupation in Japan, American foresters, including members of the Forest Service, have continued to aid the Japanese Government in the development of its forestry program. American foresters also have assisted occupation authorities in the Ryukyus, and in the American zone of Germany. During the past year, a member of the Forest Service went to Venezuela, at the request of that country, to advise in the organization of the government forestry service.

In connection with its Marshall Plan activities, the Economic Cooperation Administration gave assistance to a number of European countries in their efforts to rehabilitate their forests and wood-using industries and to improve forest-management methods and operating procedures in wood production and processing.

In the "Point IV" program of technical assistance to industrially underdeveloped areas, numerous projects have required the services of American forestry specialists abroad. The Forest Service has cooperated with the Mutual Security Agency and the Technical Cooperation Administration (through the Office of Foreign Agricultural Relations in the Department of Agriculture) in recruiting foresters, forest-products specialists, range-management experts, and technicians in related fields in response to requests for technical assistance from various countries in Latin America, Southeast Asia and the Pacific, Africa, and the Near East. The Forest Service has likewise cooperated with FAO in finding suitably trained American foresters to help man its technical-assistance projects in the member countries of that organization.

The Point IV program also includes study and training in the United States by representatives of other countries. In 1950, a group of more than 50 persons from European nations visited this country to study the American lumber, plywood and wallboard industries, and American forest-management, transportation, and sawmill techniques. Another group of 40 from tropical countries came to this country for similar studies. Last year, a group of Turkish foresters, sent by their government, were completing 2 years of study in the United States, both with the Forest Service and at American forestry schools. During the past few years, the Forest Service, forest industries, forestry schools, and other agencies have cooperated in providing special training for representatives sent from Germany, Austria, Italy, Japan, and Korea, and from a number of other countries of Europe, Latin America, and Asia.

The largest group of visitors last year included some 40 foreign nationals, representing 23 countries, who came for a 6-weeks tour of the United States to study American forest-fire-control methods and techniques. The tour was sponsored jointly by the Economic Cooperation Administration and the FAO. Forest industries, State forestry departments, and other agencies cooperated with the Forest Service in arranging and conducting the study tour, demonstrations, and training course.

These numerous foreign assignments for American foresters and the training given foreign visitors to the United States are aimed at helping the forestry programs of other countries. But the Forest Service feels that the exchange of information and the development of better understanding that results from such international cooperation are of distinct benefit to forestry in our own country.

Tropical forestry research

Research by the Forest Service in the American tropics, begun in 1939, has been centered in the Tropical Forest Experiment Station at Rio Piedras, Puerto Rico. This Station has served as a center for the exchange of forest research information among the Latin-American countries, and also to some extent for the training of forestry students from Latin America.

The research program of the Tropical Station is directed toward the discovery of practical methods of increasing forest land productivity and the utility and service life of wood in the tropics. The Caribbean National Forest, which the Forest Service also administers in Puerto Rico, serves as a proving ground and demonstration of advances in tropical forest management.

Most of the investigations have been carried out within Puerto Rico, but the forests and sites of this island are representative of many in other parts of the West Indies and the Atlantic slope of Mexico, Central America, and northern South America. Some 1,600 individual tests and investigations have been undertaken. These concern tree propagation, reforestation, improvement of existing forests, tree growth rates, stand increment and yields in different products, and the durability of wood in contact with the ground, with and without the use of preservatives.

The results of these studies include the development of satisfactory propagation techniques for more than 100 tree species, the determination of satisfactory species-site relationships for more than 60 species,

a classification of sites for use throughout the island in the selection of trees for reforestation, data on the growth rate of some 200 tree species, a satisfactory technique for the improvement of secondary forests, information as to the specific gravity and related physical and mechanical properties of more than 100 local woods, and data as to the durability of 75 species used as fence posts.

The foreign program of the Station has included active participation in international conferences for the solution of regional forestry problems. The Caribbean Forester, a quarterly, trilingual, technical journal published by the Station, has carried articles from or concerning 30 different countries. A Spanish-English glossary of forestry terminology is about half completed.

The training program of the Station, begun only recently, is steadily growing in importance. Ten foreign students have received intensive forestry training of a practical nature for periods of up to 6 months at the Station. Full use has been made of a number of favorable circumstances in Puerto Rico. The results of 30 years of administration of public forests in the commonwealth, including the application of a multiple land-use policy and the establishment of thousands of acres of plantations, are shown. The forestry extension program here, directed toward the encouragement of farm forestry, is now 20 years old. Twelve years of forest research is providing an increasingly reliable background for forestry practice. The facilities of the University of Puerto Rico, the College of Agriculture and Mechanic Arts, and those of two Agricultural Experiment Stations are available to students, as are a number of agencies working in fields allied to forestry, such as soil and water conservation and hydroelectric power development. The work in Puerto Rico shows the forest policies of the United States applied in a tropical, Spanish-speaking environment familiar to the students.

Movement Needs Our Support

Led by forward-looking programs of the United Nations Food and Agriculture Organization and the progressive efforts of many of the member nations, the world forest conservation movement is gaining new impetus. It is still in its pioneer stages; the vast bulk of the world's forests have yet to feel the touch of forest management.

This world movement can have far-reaching effects. It can alleviate the developing world-wide shortage of timber products. It can help tame floods. It can make waste lands productive again. It can lead to rehabilitation and increased productivity of range lands and so help to improve the lot of millions of people now existing on sub-standard diets. It can help toward sounder economies and improved living standards for the nations of the world.

The world forest and range conservation movement needs our strong, continued support. It is to our own self-interest that we do what we can to help bring about good forest and range management the world over. It has become the responsibility of the United States to take a leading part in the defense of free people and free institutions against the forces of totalitarian aggression. The success of the free world will depend in large measure upon its ability to produce and keep on producing. It is essential that the free world be made and be kept strong in basic resources to sustain that production.

The United States, of course, should be in the forefront among nations in developing and properly using its own forest and range resources. We still have a long way to go. In terms of application on the ground, forest conservation is much further advanced in certain other countries than here.

We do have many competent technicians in forest and range management, both in public and private employment. And we have worked out many effective techniques. Through research and experience we are constantly developing better management practices. The big jobs still to be done are to get these improved practices much more widely applied in our own country, and to assist in the development and wise management of forest and range resources in other countries seeking our aid.

THE NATIONAL FORESTS

Record Receipts

The national forests took in a record amount of money last year. The returns exceeded appropriations for protection and development of the national forests by some \$10,000,000. They nearly equaled the expenditures for all purposes, including the payments of 25 percent of gross receipts to the States.

The bulk of the receipts came from the sale of timber. The record high total reflects the current heavy demand for timber and the big increase in stumpage prices that has occurred during the past few years. Grazing fees and the leasing of land for resorts, summer home sites, and other special uses also brought in revenue.

Some individual national forests with heavy stands of commercial timber bring in very big cash returns. Others that contain large areas of noncommercial forest land produce little cash revenue, although their services in watershed protection or recreation may be of high value. A number of the national forests also include areas of recently acquired cut-over and burned-over forest land that now bring in little cash income, but as new timber growth is built up these forests will yield larger returns.

Administration of the national forests requires substantial expenditures for handling recreational use of the forests, for protecting large areas of watershed land that does not produce commercial timber, and for other activities that bring in little or no monetary returns. Expenditure of public funds for such purposes is justified by the great importance to the American people of such things as the forests' scenic values, opportunities for health-giving outdoor recreation, the reduction of flood danger, and the safeguarding of water supplies for domestic, industrial, and agricultural use. It is gratifying when the annual cash returns are large enough to cover current expenditures for all these non-revenue-producing activities, as they did last year.

But the attainment of high income is not the primary purpose of national-forest management, nor is it the principal measure of successful management. Success in the management of the national forests will be measured by the extent to which their yield of resources and services can be developed and permanently sustained, and by the degree to which the national forests can be made to contribute to the stability and sound development of communities and to the Nation's security and welfare.

States and counties share in receipts

For the most part, national-forest receipts cannot be applied directly to meet expenses nor can they be "plowed back" for the further development of the forests. All receipts, with certain relatively minor exceptions, are deposited in the United States Treasury. The funds for administration and development of the national forests are appropriated by Congress. Congress has authorized, however, that 10 percent of receipts be made available for expenditures on forest roads and trails in the States of origin.

Each year, too, under present law, an amount equal to 25 percent of the receipts is paid by the Federal Government to the States for distribution to counties containing national-forest lands. These payments are for local road and school funds. They vary widely among different counties. Some counties whose local national forests are doing a big timber sale business get very handsome yearly payments. For others, where denuded lands have been acquired for national-forest purposes, the yearly payments will be almost negligible during the period of forest restoration. A number of counties have national forests that perform vitally important watershed protection services but yield little monetary income.

Since the Federal lands are not subject to State or county taxation, the Forest Service believes that the national forests should contribute a fair share toward the maintenance of local governments.

Timber Management

The harvest of mature timber from the national forests, and cuttings made to improve conditions for growth in overcrowded stands, yielded approximately the same volume of forest products as during the previous year, 4,419 million board feet as compared to 4,688 million board feet in fiscal year 1951. Receipts from the sale of timber exceeded \$60,000,000, an all-time record high for annual value of timber cut.

A total of 23,968 timber sales was made during the year. Of these, 19,533 were small sales amounting to less than \$1,000 each; 747 were between \$1,000 and \$5,000; and 868 were over \$5,000. There were 2,820 sales of miscellaneous forest products.

Progress report on Shelton

Five years' operation of the Shelton cooperative sustained yield unit in the State of Washington has produced some substantial results. The unit, established in December 1946, committed to unified management 159,000 acres of Simpson Logging Co. lands and 111,000 acres of national-forest lands for 100 years. Allowable cut for the first 10 years was fixed at 100 million feet annually. The actual cut during the 5-year period 1946-51 was 474,215,000 board feet, of which 185,000,000 feet was cut from national-forest lands. This national-forest timber was valued at \$2,402,547, or an average of \$13 per thousand board feet, compared with the average value of \$8.43 per thousand feet of some 700 million feet cut on other parts of the Olympic National Forest during the same period. Differences in species and quality of timber, and in development and logging costs affect comparisons of this sort, but it is evident that stumpage returns in the cooperative unit compare favorably with those outside the unit.

Roads and bridges built by the company during the period cost \$1,881,000. Some 3,000 acres of national-forest land and 5,000 acres of company lands in the unit were planted during the period. Under the terms of the cooperative agreement, management of the private and public lands is coordinated on the ground through joint planning by representatives of the company and of the Forest Service. Cooperative relations have been most gratifying.

The company manufactured the timber cut in the unit in Shelton and McCleary, through the operation of two sawmills, two plywood plants, a softboard plant and a door plant. Logging and manufacturing furnished employment to nearly 2,000 persons. In Shelton and McCleary, as well as in other communities near the unit, there has been substantial growth in population, home ownership, bank deposits, stores, schools, and other community facilities during the 5 years since the unit was established. Thus, public and private timber are being harvested under a coordinated sustained-yield program with attendant permanent community benefits.

Insect control

The 1950 and 1951 control programs against the tree-killing Engelmann spruce bark beetle in Colorado, combined with natural factors such as woodpeckers, insect predators, and weather conditions, greatly reduced the beetle population in 1952. The control program necessary in 1952 therefore was much smaller than those of the two preceding years.

It is expected that only mop-up treatment will be necessary in 1953. The foresters and entomologists working on the project were highly optimistic that the beetle epidemic in Colorado has been successfully controlled.

In the northern Rocky Mountain section of western Montana and northern Idaho, however, an outbreak of the Engelmann spruce beetle started in the summer of 1952 that threatens to become one of the worst insect epidemics ever to occur in this region. The epidemic is the result of violent windstorms in 1949 which knocked down tremendous numbers of trees and so provided ideal conditions for a build-up of the beetles.

In the fight against the spruce budworm epidemic in the Pacific Northwest, the State of Oregon and the Forest Service cooperated in the aerial spraying of 665,000 acres during the early summer of 1952. This was the fourth year of this cooperative undertaking, in which a total of more than 2 million acres of budworm-infested forest has been successfully treated. In Montana, however, a budworm infestation has developed to the point where aerial spray control will be needed.

Big salvage job

Salvaging blow-down timber was a major activity in western Oregon, western Montana, and northern Idaho last year. Since 1949 each of these areas has suffered from one or more storms of hurricane force which felled "clear-cut" patches and individual trees over wide areas. Probably at least 8 billion board feet of timber was blown down in Oregon, and more than half a billion feet in Idaho and Montana. Much of the flattened timber was in rough topography many miles from roads.

Most of the damage occurred in older stands particularly susceptible to insect epidemics that might build up in the windfalls. Salvage operations were started, therefore, as soon as possible in the heaviest concentrations of dead and dying trees, in the hope that insect depredations could be prevented from multiplying the loss that had already occurred from blow-down.

National-forest timber sale and access road programs were promptly reoriented to meet the emergency. Excellent cooperation was obtained from local landowners and timber purchasers. Several private operators completely changed their logging plans in order to salvage blow-down timber on national forest as well as on their own lands.

With the outbreak in 1952 of the Engelmann spruce beetle in Idaho and Montana, and of the Douglas-fir beetle in Oregon, salvage efforts were increased. They will include the harvesting of as much of the infested timber as possible.

Growth increasing in eastern forests

The national forests east of the Great Plains contain 20 million acres of commercial forest land; nearly all of which was acquired by the Government through purchase. Most of the timber stands had been badly depleted by cutting and fire. The recovery brought about by fire protection, planting, and forest management is most gratifying. The key to rehabilitation is to increase the forest capital by cutting each year less timber than grows, so that future yields will be much greater and of higher quality.

In 1952 the total saw timber and pulpwood cut from these eastern forests was equal to about 40 board feet per acre of commercial forest land. This is estimated to be less than half the current annual growth on these lands. The remainder is being added to growing stock, or forest capital. Over a period of years, during which additional improvement and salvage cuts will be made, more fully stocked forest stands will result. The annual cut can be increased during this period, so that these public forests will yield increasingly greater returns.

New timber growth in the national forests of the Lake States has already made it possible to raise the allowable annual cut from 300,000,000 feet to 425,000,000 feet. Within 10 years it should be possible to make a further increase. Pulpwood now represents about 75 percent of the volume cut annually, and the large Lake States pulp and paper industry, using nearly 3 million cords a year, is looking to the national forests for a large part of its raw material. The pulpwood industry uses small material, which means that forest management can be more intensive than where only sawlogs are marketable.

The Davy Crockett National Forest in Texas provides a good example of progress in intensive management. This area of about 160,000 acres was purchased as cut-over land 15 to 20 years ago. In 1937 the area had an estimated 319 million board feet of pine saw timber, plus an undetermined amount of pine pulpwood. By last year the volume of pine saw timber had more than doubled, and the total pine volume, saw timber, and pulpwood, had increased to an estimated 1.3 billion board feet, even though some 168 million board feet had been cut from the area. Only a part of the annual growth will be cut until the timber stand reaches about 2 billion board feet. At

current growth rates this goal will be reached in another 15 years. Then the area should yield something like 100 million board feet of pine timber—sawlogs and pulpwood—a year, or over 600 board feet per acre per year, continuously.

Roads key to full harvest in western forests

Commercial timber areas in the western national forests include a substantial acreage of mature and overmature timber. Losses in such timber stands are high as a result of fires, insects, and diseases—overmature timber is especially vulnerable to insect and disease attacks. Good timber management calls for cutting in these stands to reduce the susceptibility to loss and to place them in condition for good growth to help meet future requirements for timber products.

Approximately 1.4 billion board feet of timber was cut from the western national forests in 1940. By fiscal year 1952 the cut had been increased to 3.5 billion board feet. To increase the yearly cut to the sustained yield capacity of each working circle, or even to maintain it at the present level, timber access roads will have to be constructed into areas now inaccessible. A permanent system of timber access roads will help in reducing losses from fires, insects, and diseases, by making it possible to harvest overmature timber before it is attacked or killed, and by providing accessibility to conduct direct pest-control operations.

Of the total mileage of road construction and reconstruction that the Forest Service estimates will be needed to maintain the present rate of cut and to increase the annual cut on all national forests to the currently obtainable sustained yield capacity of 6.6 billion board feet a year, about 80 percent is needed on the western national forests. Roads in the western forests are therefore the key to attaining full timber harvest and net growth in the national forests. Millions of acres of wild forest land must await an adequate road system before they will return their full worth in forest products and in growing capacity. As these acres now stand, undeveloped, a large part of their growing capacity is continually being wasted by fire, insects, diseases, and wind.

The costs of timber access roads are more than returned by the timber made accessible and cut. Larger timber operators usually have the equipment and means to build roads needed in connection with their operations, but if the national forests are to continue to supply timber to the smaller timber operators dependent upon national-forest timber for their supplies, the Government will have to build some of the access roads. Access road construction in the rugged country of the West is often a formidable job, requiring equipment, engineering skills, and means beyond those possessed by smaller operators.

Reforestation

During fiscal year 1952, 49,636 acres of national-forest land were planted or seeded to trees. This brings the total of successful national-forest tree plantings to 1,445,666 acres. Most of last year's planting—some 28,000 acres—took place west of the Great Plains. Approximately 21,000 acres were planted in the eastern national forests.

Of the total area planted and seeded, some 60 percent was accomplished on recently cut-over areas with funds deposited by purchasers of timber, under terms of the Knutson-Vandenberg Act of 1930, for reforestation or stand improvement of timber sale areas. Slightly less than 20,000 acres were planted in other areas, with funds appropriated by Congress. The total acreage planted covered only a small fraction of the 4 million acres in need of reforestation.

On some cut-over and burned-over areas where seed trees are still present, satisfactory natural regeneration can be obtained by site preparation. This may involve scarification of the soil surface, or poisoning seed-eating rodents, or both, just prior to seed fall. Some 42,000 acres were so treated during the year.

Timber stand improvement

Funds collected in connection with timber sales, under authority of the Knutson-Vandenberg Act, provide the means for establishing natural tree growth and protecting it during its early stages, and for doing some work to improve the future stand of timber on timber sale areas. Such work often results in eliminating the need for costly planting and seeding of cut-over areas. It brings increased growth of immature timber of desirable species. In addition, growth of higher quality is being obtained. During the past fiscal year the following work was done under this act:

	<i>Acres</i>
Plantation release.....	6, 753
Natural stand release, weeding and thinning.....	258, 370
Pruning.....	85, 689
Animal control (hogs, etc.).....	74, 481
Rodent control.....	1, 830
Disease control.....	37, 823
Other.....	10, 239

Additional timber stand improvement work was accomplished in stands of promising young growth, not associated with current timber sales, as follows:

	<i>Acres</i>
Plantation release.....	20, 096
Natural stand release, weeding and thinning.....	20, 094
Pruning.....	272
Animal control (hogs).....	102, 401
Rodent control.....	16, 652
Disease control.....	58, 302
Other.....	22, 202

Range Management

The Forest Service issued 19,708 pay permits to livestock operators for the grazing of 1,088,215 cattle and 3,012,712 sheep on national-forest ranges in 1951. In addition 4,368 owners grazed 47,283 cattle, 5,353 sheep, and 1,210 swine under regulations allowing free grazing permits to local settlers.

Except in parts of the Southwest where cattle grazing on the ranges is predominantly year-long, most national-forest ranges are used seasonally, during the spring, summer, and fall months. For cattle the average grazing season is about 5 months; for sheep, about 3 months. In 1951 cattle grazed national-forest range for a total of 5,598,880 months; sheep for a total of 7,668,151 months.

The grazing fees on the national forests are adjusted each year in accordance with market prices of livestock for the preceding year. Because of the high market prices received by producers in 1951 for beef cattle and lambs, the grazing fees reached an all-time high in 1952, averaging 64 cents for cattle and 15.25 cents for sheep per head per month. Total grazing receipts for the fiscal year 1952 amounted to \$5,022,654.

Range improvements

For fiscal year 1952 Congress appropriated \$700,000 for range improvements and approximately \$725,000 for range revegetation on the national forests. In addition to necessary maintenance work on existing improvements, new improvement work accomplished included construction of 230 miles of range fence and corrals, 6 miles of livestock driveways, and 157 water developments. Approximately 56,000 acres were reseeded to palatable forage species, bringing the total area of national-forest range land revegetated to date to 450,000 acres.

In the control of poisonous plants, substantial progress is being made against infestations of goatweed or Klamath weed (*Hypericum perforatum*) on national-forest ranges where the plant has become established. Goatweed, a European plant that has gone wild in this country, has been spreading rapidly since its introduction on the west coast about 50 years ago. Invasions of the plant result in marked reduction in grazing capacity; also it is poisonous when eaten in quantity by livestock. The Bureau of Entomology and Plant Quarantine has demonstrated that control can be obtained through the colonization of two imported beetles, *Chrysolina gemellata* and *C. hyperici*, which feed exclusively on this weed. Release of these insects in California has resulted in spectacular control of the weed. In the northern Rocky Mountain region, cooperative effort by Federal and State agencies, local organizations, and individual ranchers has brought about the introduction of more than 80 colonies of the insects on national-forest and private ranges. Indications of success are very favorable, and use of the beetles is expected to eliminate need for an expensive chemical control program.

Condition and trend study

An important recent development was the completion of the "condition and trend" study, mentioned briefly in last year's report. The study, begun in 1948, resulted in what is known as the "three-step method." This incorporated ideas from many other measurement methods that had been developed in the past for keeping track of what is happening to a range. The three-step method took from these the main features agreed upon as essential, and simplified them for general application to range areas. Special effort was made to develop a method that would not be too time consuming and yet would be subject to a minimum of error from personal differences in application. Range research specialists and range administrators of the Forest Service cooperated in the study.

The three-step method has proved to be reasonably rapid and accurate. Little variation occurs when different persons apply it. The method was found to be sensitive in reflecting changes in condition on a wide variety of range types. It is recommended for use primarily on the perennial grasslands, including mountain meadows,

open timber, and sagebrush-grass types, typical of large areas of national-forest range in the West. Tests of application on range units or grazing allotments have been carried out in Oregon, Montana, California, Arizona, and New Mexico.

In brief, the three-step sampling procedure consists of—

1. Measurement and observation of the essential features of vegetation and soil as recorded on permanently established transect lines and plots located on the usable parts of the range. Measurement is made by means of a small ring or loop at 100 points along each transect line.

2. Classification of these data as to condition of vegetation and soil stability and estimation of current trend in condition.

3. General and close-up photographs from permanently located photo points.

Application of the three-step method on an allotment basis requires mapping of the usable range areas by broad vegetation types and by condition situations within these types as a prelude to sampling. Trend is determined by comparison of records made at periodic intervals.

The three-step method has been adopted for general use on western national-forest ranges. It has been favorably received by stockmen and by representatives of other Federal and State agencies interested in range management. It appears to be a method of determining range trends which both stockmen and national-forest administrators can readily understand, and one in which they will have mutual confidence as an important aid in planning sound management of range areas.

Watershed Management

National forests are the principal water-source lands in the western States. They embrace the headwaters of nearly all the major streams, the higher elevation areas where the most precipitation falls and where more of it is in the form of snow. Good watershed management in the western national forests is therefore of vital importance in attaining regular, controllable water flows, modification of the peaks of floods, and dependable water supplies of good quality for western communities.

East of the Great Plains, national forests cover a much smaller proportion of the headwater areas of streams, but they do include many lands that are of great importance in local and regional water supply and flood control.

East and West, the main objective of watershed management is to get more water delivered into and through the ground, rather than to have it rush away in rapid, wasteful, soil-washing surface runoff. It is water that goes into the ground that comes out later as spring flow to feed clear streams and extend their flows into summer seasons, when water is most needed.

Generally, what is good land treatment from a watershed standpoint is also good management of the timber, range, recreation, and wildlife resources. Many areas, however, require special treatments to remedy bad watershed conditions resulting from forest fires, past overgrazing, or other causes of damage.

The Forest Service during the year expended approximately \$30,000 of flood-control funds on two emergency projects, under authority of the Flood Control Act of 1938 and subsequent acts. Both of these activities, one in California and one in New Mexico, were occasioned by forest fires which, by denuding mountain watersheds of vegetation, had created unusual flood threats to downstream areas. Emergency

measures included seeding of burned slopes with rapidly growing plants, and, where necessary, construction of small debris-retaining structures to afford downstream protection until the upper slopes become revegetated.

In Idaho, the Forest Service and the Bureau of Reclamation are co-operating on a watershed program in the Willow Creek drainage above the Arrowrock Reservoir. Prior to the present cooperative program the Forest Service reseeded 1,200 acres of range land in the Boise National Forest, and built several miles of fence to protect the area from livestock drifting in from outside range. During the last 3 years, with funds provided by the Bureau of Reclamation, the Forest Service has reseeded approximately 1,200 acres of Reclamation-withdrawn lands immediately tributary to the reservoir. Loose rock gully plugs and sediment-control dams have been constructed in the channels of intermittent streams that were degrading rapidly as a result of accelerated runoff due to loss of vegetal cover in the area. Also, the fencing of sections of channel so that willows in the channels may multiply is aiding in controlling soil movement. Destruction of the channel vegetation by fire and overgrazing was one of the things that caused the channels to cut out. Although the program in the Willow Creek Watershed is still in its early stages, a significant lessening of sediment loads carried into the Arrowrock Reservoir already is evident.

On Meadow Creek in central Utah, local stockmen and water users cooperated with the Forest Service in contour trenching and reseeded 200 acres of badly depleted lands. Several thousand acres in the watershed need special measures to increase plant cover and forage, reduce soil erosion, and prevent flood damage from torrential rains.

Problems of runoff and erosion caused by logging roads and skid trails have become worse in recent years, especially in the East, because of increased use of tractors and bulldozers in logging operations. In earlier times, most of the log skidding in the East was done with animals, with only moderate disturbance of the forest soil. Now, with heavy mechanical equipment, the job of laying out skid roads that will not develop into gullies is more difficult.

In present-day timber sale contracts in the national forests, therefore, more attention is being given to water- and soil-conservation requirements. Contracts may specify limitations with regard to location and grades of logging roads and skid roads, the drainage structures to be installed, log landing locations to minimize stream deterioration and erosion, and rules for cutting and skidding along stream courses. Protective measures to control water flow and erosion may be required during and following the close-down of sale operations until new vegetation has obtained a foothold on exposed soil surfaces. These special requirements are adapted to fit the local situations.

Recreation

Public use of the national forests for recreation increases steadily. In 1951 the national forests received 30 million visits, a 9-percent increase over 1950 and a 66-percent increase over 1941, which was the year of highest prewar use. For 30 percent of the visitors, general enjoyment of the forest environment was the primary purpose of

their visit, and another 24 percent were picnickers. Fishing, hunting, winter sports, camping, swimming, hiking and riding were other recreational activities.

Moderate charges for camping, picnicking, and swimming were continued at some of the larger, suitably developed recreation areas last year, so that the recreational activity might return some part of the cost of operation and maintenance. On a number of these areas the Forest Service was able to get competent concessioners to take over operation and maintenance, thereby relieving the Service of the cost of operating and maintaining them. This saving enabled forest officers to spend more time and money on the many smaller recreation areas where no charge was made. At most of the areas operated on a charge basis, the charge was 25 cents to 50 cents per party of six for picnicking, and 50 cents a night or \$3 a week for a party of six for camping; but at a few of the more highly developed recreation areas in the East, such as the Sherando Lake, High Knob, and Cave Mountain areas in Virginia, and Twin Lakes in Pennsylvania, a charge of 25 cents a day was made for adults and 10 cents a day for children.

In addition to the concessioner-operated areas, the Forest Service also operated some charge areas with its own personnel.

Facilities overtaxed

The operation and maintenance of free recreation areas by the Forest Service is becoming increasingly difficult as the facilities and improvements become older and as recreation use continues to increase. At many areas sanitary facilities and water systems are unsatisfactory and do not meet the minimum standards of the United States Public Health Service or of the States. Public health and safety are being endangered. Better sanitary facilities are badly needed but funds to provide them have been lacking.

Many camping and picnic grounds near population centers are frequently used far in excess of their capacity. Such overcrowding increases the rate of deterioration of the site and overtaxes the already inadequate sanitary facilities. Additional facilities are needed at many locations. The present capacity of all camp and picnic areas—41,000 family-sized units, 310,000 people—needs to be increased by some 10,000 units to relieve present overcrowding.

Because of inadequate facilities and overcrowding at existing areas, many people camp or picnic on unimproved areas where there is danger of polluting water that is used for domestic purposes. The risk of costly forest fires is greatly increased when the camper builds his fire in locations that have not been developed, fireproofed, and provided with fireplaces where camp fires can be built with reasonable safety.

Under existing law, the Forest Service cannot use any part of the national-forest receipts for maintenance or improvement of recreational facilities. For funds to provide satisfactory sanitary facilities and put other facilities in good condition at existing recreation areas and to develop new areas to accommodate the increasing demand for national-forest recreation the Forest Service must depend upon direct appropriations.

Winter sports

Winter sports areas in the national forests had almost 2 million visits in 1951, an increase of 28 percent over 1950.

In many areas during the winter of 1951-52, snow depths were from 30 percent to more than 100 percent above normal. Numerous snow avalanches blocked major highways and caused much damage. At least 18 persons were killed by snow slides in the West. But at national-forest ski areas supervised by Forest Service snow rangers there were no avalanche fatalities nor property losses, although some of these high alpine slopes that are most popular with skiers are also subject to the greatest avalanche hazards. The value of avalanche control techniques developed in recent years by Forest Service officers thus was emphatically demonstrated. The Forest Service has received requests from other Federal and State agencies and from public utility companies for assistance in combating the avalanche hazard.

The Forest Service is continuing its studies of avalanche control. Basic snow data were gathered last year at the Alta ski area in Utah, Berthoud in Colorado, and the Stevens Pass and Mount Baker ski areas in Washington.

Wilderness areas

The 78 national-forest wilderness areas, totaling some 14 million acres, are being used by increasing numbers of wilderness devotees. Protection and management of these areas pose many problems, especially those brought about by private holdings within the wilderness area boundaries, by the application of the mining laws to lands in these areas, and by demands for commodity uses and for roads and airfields in the areas.

That there is widespread interest in wilderness recreation is evidenced by the attendance at public hearings which are held whenever a change is proposed. At a public hearing conducted by the regional forester for the southwestern region in August 1952, relating to proposed changes in the Gila Primitive Area, Gila National Forest, N. Mex., more than a thousand people made statements. The record of the hearing showed that the interest was national in scope.

The President's Executive order creating an airspace reservation within which flying was banned over the Superior roadless areas in Minnesota became fully operative on January 1, 1952. The airspace ban was immediately challenged by several persons who made deliberate violations to test the legality of the order. The Department of Justice entered suit, asking an injunction. The decision of the United States District Court of Minnesota upheld the validity of the airspace reservation.

Special Land Uses and Mining***Special uses***

Use of national-forest land for various specified purposes may be authorized by special-use permit. More than 50,000 permits were in force during the year for a wide variety of purposes, including summer homes, resorts, ski lifts, pastures, pipe and telephone lines, fences, etc. Some 21,600 permits for uses of a noncommercial nature were issued free. Charge permits yielded \$666,197 in fiscal year 1952, an increase of \$10,000 over 1951.

Mining leases

Approximately $3\frac{3}{4}$ million acres of national-forest land are under lease or permit for exploitation of oil and gas or other minerals, under the acts regulating leasing of acquired land and public land. Most applications received during the year were for leases in western and southern national forests. There were also a number in Ohio and Michigan, and considerable interest was evidenced in oil and gas on the Monongahela National Forest in West Virginia. Extensive prospecting for lead is under way in the Ozarks of Missouri and for copper and nickel in the Superior National Forest in northern Minnesota. The Forest Service made 235 reports on applications for mineral permits and leases on acquired lands during fiscal year 1952. The Bureau of Land Management issued 285 leases covering 160,000 acres of acquired national-forest land. These leases and permits yielded a revenue of \$238,233 during the fiscal year 1952, an increase of \$89,475 over 1951.

On lands acquired under terms of the Weeks law, the Secretary of the Interior, with the consent of the Secretary of Agriculture, may issue leases for the exploitation of minerals. In reporting on applications for such leases, the Forest Service seeks both the furtherance of mineral production and the protection of surface resources for timber production, watershed protection, forest recreation, and wildlife, in line with the basic multiple-use policy for the national forests. In each case a determination must be made as to whether mineral use can be carried out in harmony with the surface uses, with or without special requirements to protect those uses. Where harmonious utilization is impractical a determination of relative values is made. It may be determined, for example, that, in the best public interest, strip mining should be prohibited altogether on a valuable watershed or recreation area, but that it should be permitted in areas where minerals are the most important resource. When mineral development results in destruction of the surface, the operator is required to restore the surface to productivity and to reimburse the United States for surface values destroyed.

The United States mining laws and mining claims

The Forest Service wishes to encourage proper mineral exploration and development in the national forests. In those national forests created from the public domain, the general mining laws give any individual the right to locate, enter, and patent mining claims on national-forest land. The law makes no requirement, however, that mining be done on the land after patent, and it provides no checks against damage to soil, timber, water, or other values. The law is vulnerable to abuses, and it results in many mining activities decidedly contrary to the public interest. Other values far in excess of the mineral values often are included in mining claims. Timber values of \$25,000 or more per 20-acre claim are not uncommon in the national forests of California and the Pacific Northwest. There is need for revision of the mining laws so that the surface resources and values of the national forests will be safeguarded without impairing bona fide mining development. Separation of the surface and mineral

values is desirable, with the mineral locator or patentee acquiring the right to use as much of the surface or timber as may be necessary in the development of his claim.

Wildlife

More and more people are taking an interest in hunting and fishing. But each year more private lands are posted, and more restrictions are being applied on many of the private lands still open to sportsmen. The result is that hunting and fishing "pressure" on the public lands is rapidly increasing. The national forests, because they comprise the largest area of publicly owned, good-quality wildlife habitat in the United States, are feeling this pressure more than ever before. Last year an estimated 5½ million hunters and fishermen visited the national forests. They bagged a total of 358,000 big-game animals. Fishermen and small-game hunters likewise had excellent sport. The fishermen had at their disposal 81,000 miles of streams and 1,650,000 acres of natural lakes supporting a large variety of game fish.

If the national forests are to keep up with the demands for high-quality hunting and fishing, more intensive habitat management will be essential. The management work on the ground must be backed by further development of habitat-management techniques. This is especially important where management of wildlife habitat involves modification in the management of other resources such as timber and forage. Much more knowledge is needed.

The Forest Service and State wildlife conservation agencies have made much progress in the development of cooperative wildlife management programs. There are possibilities, however, for much further development of the national-forest wildlife potential through such cooperative programs.

State wildlife conservation agencies find certain advantages on national-forest areas. In addition to the important matter of providing free access to sportsmen, the national forests offer greater continuity in type of land management and greater stability of management policy than may be found on many private lands, even when these lands may be open to public hunting and fishing. Moreover, the Forest Service attempts to give purposeful management to the wildlife habitat in the national forests and to coordinate the wildlife-habitat management with other phases of forest management.

Examples of progress

Substantial progress in Forest Service-State cooperative wildlife management occurred in a number of States during the past year. In West Virginia a new State law was enacted providing for special stamps for hunting and fishing on national-forest land in the State. The funds collected by the State through sale of these stamps will greatly strengthen an already fine cooperative management program. Recent adoption of a similar stamp by the State of Florida for special areas in the national forests likewise will make possible a more intensive cooperative wildlife management program in that State.

A new cooperative wildlife management area was established during the year in the Conecuh National Forest in Alabama.

In Pennsylvania, a unit manager has been assigned by the State to one of the cooperative management areas in the Allegheny National Forest. Habitat-improvement crews made excellent progress during the year.

Arizona has a unit manager assigned to the Three Bar Cooperative Quail Management Unit in the Tonto National Forest. A long-time habitat-improvement program is planned. The cooperative program for Arizona's famous Kaibab National Forest deer herd was strengthened by an increased contribution of State funds.

The cooperative wildlife management program in Virginia, now in its thirteenth year, saw development of new techniques in habitat management in the George Washington and Jefferson National Forests. An experiment with controlled hunting was tried for the first time.

In the management of big-game herds in the national forests, overpopulation is still a problem in many places, and in some areas it is becoming more critical. However, several States have taken new steps toward meeting the problem. New legislation providing for more liberal harvesting of antlerless deer has been enacted in Pennsylvania, West Virginia, and Utah. Management programs which resulted in more adequate harvests of surplus big game were started or continued in several other States.

Some progress has been made in developing coordinated habitat-improvement techniques that may be suitable for application on a broad scale. In the Pisgah National Forest in North Carolina, experiments indicate that an abundance of deer browse can be produced in hardwood forests through clear cutting in limited areas or heavy selective cutting, which at the same time is within acceptable limits of good management from the standpoint of timber production.

Methods of revegetation of depleted browse range for big game were studied in Oregon and Idaho. Results with such important species as bitterbrush, while not conclusive, gave promise of developing suitable revegetation procedures. Studies on the relationship between logging and fish and game habitat were started in Colorado and in Oregon.

Fire Control

During the calendar year 1951, the Forest Service controlled 10,385 forest fires in the national forests. This exceeded by 282 the number of fires fought during 1950. In the first 6 months of 1952, 3,459 fires were fought and controlled, compared with 3,519 fires in the same period of the preceding year.

The incidence of lightning-caused fires was unusually high in several localities during the late summer months of 1951, notably in northern California, where a larger concentration of forest fires from a single thunderstorm occurred than in any other recent year. In this area 565 fires developed from a single storm in August. Because sufficient attack forces were not available to control all these fires while they were still small, it was necessary to recruit 4,800 men to help control those that became large.

During 1951, 383,886 acres of forest and watershed inside the national forests were burned over, compared with an annual average for the preceding 5 years of 233,084 acres.

From January 1 to August 31, 1952, 59,819 acres were burned, compared with a 5-year average for the period of 186,516 acres.

Severe drought conditions prevailed in New Mexico, Arizona, and California during the 1951 fire season. Western Washington and Oregon experienced the driest fire season since 1922—so dry that commercial lumbering was halted for a period in late summer by order of the State authorities. Southern Colorado, Nevada, and Utah suffered from a prolonged drought, as did localized areas in other States.

The summer and fall season in 1951 was one of the worst periods for the national forests in many years, measured in terms of timber killed and other resources damaged by fire. A billion board feet of timber was killed—sufficient, if cut into lumber, to build 100,000 small family homes. About 100,000 acres of young growth upon which future timber crops depend was destroyed. Watershed damage was heavy, particularly in California, New Mexico, and Arizona. Damaging flash floods have already resulted from heavy rains falling on some of the areas burned in 1951. There were many additional losses to local communities, such as loss of water for irrigation, hydroelectric power, and domestic uses, and loss of business and employment.

Fire line construction and use of specialized equipment

It was necessary to construct 3,700 miles of fire line to control the 10,385 fires that occurred in 1951. Such a line-building job is a burdensome undertaking when much of it must be accomplished during hours of darkness in rough, mountainous country, and with the fire often pressing to break over the line.

Tractor dozers and plows were used to construct approximately 1,800 miles of the fire line during the year. Tank trucks were dispatched to 2,200 fires. Communication on fires was improved by the use of 6,000 radio transceivers. Power saws were used to fell thousands of snags along fire lines and thus prevent spot fires. Such use of specialized equipment saved thousands of acres of forest land which undoubtedly would have burned if forest officers had had to rely wholly on hand tools to gain control of the fires. Additional modern equipment could do much to increase the effectiveness of the manpower available.

Use of aircraft

Airplanes were used during the year to transport more than 12,000 men and approximately 2,000,000 pounds of fire supplies, of which about a million pounds were dropped to fire fighters working on fires in inaccessible country. Approximately 12,000 hours of flying were necessary. In addition more than 1,000 flights were made with helicopters.

Smokejumpers made 1,200 jumps to 334 fires during the year. About \$750,000 of fire-suppression costs were saved because smokejumpers arrived on fires early enough to control them.

Missoula smokejumper headquarters

For the fiscal year 1953, Congress made a special appropriation to provide new headquarters for the Forest Service smokejumper corps. Work has been started on a 150-man dormitory, parachute loft, and warehouse, adjoining the Missoula airport in Montana. This smokejumper plant will replace temporary buildings used heretofore which

are no longer suitable and are poorly located for prompt get-away to fires. It is expected that the new headquarters will be completed in time for use during the 1954 forest fire season.

Losses not inevitable

Damages caused by forest fires were very severe last year in the areas where drought, high-velocity winds, and prolonged periods of high temperatures occurred during the fire season. The fact that heavy resource losses are usually associated with such bad fire weather conditions does not mean, however, that disastrous losses must be considered inevitable whenever the weather is unfavorable. On the contrary the potential effect of critical fire weather on resource losses can be greatly lessened through adequate implementation of fire plans designed to control, in their incipency, the fires which occur under such conditions. Hence, the heavy losses during the last half of 1951 cannot be charged to critical fire weather conditions alone. They are due in part at least to the fact that the Forest Service still lacked the manpower and equipment for a fire organization adequate to cope with all fires occurring under severe burning conditions.

The cost of fire fighting has risen. In 1920 fire fighters could be hired for 20 cents per hour. During the 1927-38 period hourly wages were about 35 cents. In 1946 they rose to 77 cents. In 1951 the Forest Service had to pay average hourly wages of \$1.15 per hour for fire fighters. Other operating costs have increased in the same proportions. Thus, the dollars made available to the Forest Service for fire control today buy much less than they used to in manpower and equipment.

With the help of the Civilian Conservation Corps, the Forest Service was able to construct many fire-control facilities, such as telephone lines, lookout towers, and guard cabins during the 1930's. Many of these facilities have now depreciated to a point where heavy maintenance or complete replacement is required. Maintenance and construction funds available have not been sufficient to accomplish the rehabilitation job.

With the new types of equipment and modern techniques now available, the Forest Service has developed plans which it is hoped will assure early control of practically all fires, even those starting under the most unfavorable fire weather conditions. It is confident that the large resource losses which now occur each year in which fire weather conditions are critical, can be stopped when the Service is able to put into operation fully the fire-control plans that have been developed to protect the resources of the national forests.

Improvements and Facilities

Roads and trails

A total of \$18,590,105 was made available for construction and maintenance of national-forest roads and trails in fiscal year 1952. Of this total, \$13,000,000 was from appropriations authorized by section 3 of the Federal Aid Highway Act of 1948, and \$5,590,105 was "10 percent funds"—10 percent of national-forest receipts for fiscal year 1951—allocated for roads and trails as authorized by the act of March 4, 1913. The funds were programed as follows: \$8,553,000 for maintenance of 206,719 miles of forest development roads and trails;

\$2,700,000 for replacement of 577 unsafe bridges on national-forest roads and trails; \$2,696,605 for reconstruction and surfacing on 643 miles of roads, of which 393 miles are used in hauling timber; and \$4,640,500 for construction of 157 miles of new timber access roads in Arizona, California, Idaho, Minnesota, Oregon, and Washington.

Supplementing the construction work of the Forest Service, purchasers of national-forest timber are building approximately 1,500 miles of permanent road annually as part of timber-sale agreements. Combined purchaser and Forest Service timber access road construction and reconstruction for fiscal year 1952 totaled some 2,050 miles.

Recent Forest Service estimates indicate that about 1,900 miles of road construction and reconstruction will be needed annually for a period of 5 years in order to maintain the present annual cut in the national forests. During the same period, to make the currently attainable sustained-yield capacity of 6.6 billion board feet annually available from the national forests, an additional 7,200 miles of road must be built. Timber road construction and betterment at the 1952 rate of 2,050 miles per year will provide the roads necessary to maintain the current cut, but will allow only slight progress toward making additional timber available. At this rate, some 50 years would elapse before the current rate of construction would make the currently estimated capacity of the national forests available for peacetime use, or accessible in case of a national emergency. The need for accelerated construction of timber access roads continues to be acute.

Transportation system

The existing national-forest transportation system consists of 133,259 miles of forest highways and truck roads, 124,700 miles of horse and foot trails, and 112 airplane and helicopter landing fields. States and counties maintain 40,030 miles of the forest highways and roads on the national forests; 10,510 miles of road are maintained by purchasers of national-forest timber and other users of national-forest roads; 700 miles of trail are maintained by cooperators. The remaining 124,000 miles of trail and 82,719 miles of road are maintained by the Forest Service.

In the national-forest transportation system, 58 percent of the road mileage, 75 percent of the trail mileage, 35 percent of the 11,000 road and trail bridges, and 30 percent of the landing fields are of suitable standard and in suitable condition for all general purposes and public use. The remainder of the transportation-system facilities are usable for fire protection but are usually inadequate for other classes of traffic and often unsafe for public use. Originally built to low standards and primarily for fire protection, these roads and trails and bridges were neglected during World War II when maintenance work was largely suspended. Since 1946, 2,931 of the most critical bridges have been replaced. Additional replacements are scheduled at the rate of 600 per year, with culverts replacing about 40 percent of the former bridges. Reconstruction of former protection roads to accommodate recreation and other public traffic is proceeding slowly while the urgency of timber access road construction gives prior emphasis to construction or reconstruction for that purpose.

Water developments

During the year more than 50 dams were built on national-forest lands by irrigation farmers, power companies, and Federal agencies

(Bureau of Reclamation and Corps of Engineers). The many proposals for multiple-purpose water developments in mountainous head-water areas, where the national forests lie, bring new problems of insuring proper consideration for forest resources such as timber, recreation, wildlife, and grazing in the areas involved.

Power projects totaling in excess of a million horsepower are currently under construction on the national forests. Demands for additional hydroelectric energy presage continued activity in this field. Use of the new power created will mean additional wealth for the local communities. Last year more than 1,000 power cases were handled by the Forest Service, collaborating with the Federal Power Commission. These brought into the Federal Treasury over a quarter of a million dollars in right of way charges.

Ten reservoirs were built wholly or partly on national-forest lands by farmers for irrigation storage: two in Montana, two in Colorado, one in Arizona, two in Utah, two in Idaho, and one in Oregon.

Mapping

During fiscal year 1952 the Forest Service cartographic organization completed control surveys and topographic maps for 1,540 square miles of national-forest and adjoining lands in Arizona, California, Idaho, and Kentucky.

Planimetric maps were completed on 14,700 square miles of national forests and adjoining lands in Montana, Oregon, Washington, California, Colorado, New Mexico, and Pennsylvania.

Contracts for aerial photography for both national-forest mapping and resource inventory purposes were awarded for a total of 20,117 square miles. Bids were pending at the end of the fiscal year for an additional 8,752 square miles.

Thirty-five national-forest administrative and recreation maps were printed during the year.

A procedure was developed whereby old public-land surveys and metes-and-bounds property lines may be retraced with the aid of aerial photographs and photogrammetrical processes, transferred to maps and reestablished on the ground at far less expense than costly resurveys by conventional methods. This will reduce the cost as well as expedite action on many boundary surveys required in connection with timber sales, control of trespass, and other administrative problems.

Housing

The Forest Service is faced with an acute problem in providing housing for employees at outlying stations where commuting from centers of population is impractical. Many stations built 30 or 40 years ago are inadequate for present-day needs. Many have now deteriorated beyond the point of practical repair. The high percentage of men with families among new employees recruited largely from the ranks of World War II veterans make more family quarters necessary at ranger stations than was the case in earlier years. Resourceful forest supervisors and district rangers are able to meet the situation in some cases by converting former equipment sheds to dwellings, salvaging some CCC and Army camp buildings and moving others closer to fire-control and work centers. Improvement construction funds available after the maintenance of existing structures have permitted construction of only 6 or 7 new residences annually during recent years.

Equipment

The Forest Service inventory of equipment for administration, fire protection, tree planting, range reseeding, road maintenance and construction in 1952 consisted of 6,400 passenger-carrying and transportation vehicles, including fire trucks; and 1,200 tractors, graders, compressors, and similar units of construction equipment. The 1952 inventory of transportation units was slightly less than that of a year earlier, 5 percent less than that for 1947, and 20 percent less than the 1941 inventory.

The 1952 construction equipment fleet was 1,000 units below that in use before World War II. The reduction is due in part to smaller construction programs. Also more of the heavier construction is now being contracted; and there has been continuous effort to improve work scheduling, including staggering work when possible on adjoining or nearby national forests in order to make each piece of equipment available for two or more forests.

National Forest Properties

National-forest properties on June 30, 1952, included 153 national forests, 31 purchase units established with approval of the National Forest Reservation Commission pursuant to the Weeks law, 16 experimental forests, and 12 land utilization and other projects. These included a gross area of 229,164,852 acres and a net area of national-forest land and other land administered by the Forest Service of 181,130,393 acres.

The significance of these national-forest properties, however, is much greater than can be indicated merely by number of administrative units or number of acres. These lands are parts, and in some instances the major parts, of the watersheds of many of our important streams. They include some 76,000,000 acres of commercial timberland managed with the objective of producing continuous crops of timber for the industries and commerce of the Nation. They include grazing lands important to the livestock industry. They provide a great number of recreation areas, where millions of our people hunt, fish, camp, or picnic, and enjoy the scenery and forest environment each year. The national-forest properties thus mean regulated water flows, forage for livestock, a sustained flow of raw materials for all the products made of wood, and a sizable contribution to business enterprises and permanent payrolls that are part of the economic backbone of the Nation.

Land purchases

For the fiscal year 1952 Congress appropriated \$75,000 for the purchase of lands in the national forests under the Weeks law of 1911; \$138,996 pursuant to the several "receipts acts," and \$125,000 for acquisition of privately owned lands within the Superior National Forest roadless area, as authorized by Public Law 733 of the Eightieth Congress. The National Forest Reservation Commission approved the purchase of 6,154 acres of lands from the Weeks law funds; 3,864 acres involving 16 tracts were approved for purchase with funds appropriated under the receipts acts; and 3 tracts comprising 163 acres were approved within the roadless area of the Superior National Forest. The greater part of the appropriations for consolidation of the Superior

roadless area are being held pending the working out of transactions involving certain key tracts on which commercial resorts are now operating. The appropriation for purchases of land pursuant to the Weeks law made possible the acquisition of a number of tracts needed for more economical forest management.

Forest exchanges and donations

The exchange of national-forest land or timber for privately owned, county, or State lands within or near the national forests also provides an opportunity for adjustments of land use and ownership in the interest both of improving opportunities for private forest management and of more economical national-forest management and better resource use. During the fiscal year, 175 exchanges were approved, in which 85,970 acres of land were offered to the Government in exchange for 23,238 acres of national-forest land and 63,033,000 board feet of national-forest timber.

In addition to the purchase and exchange transactions, 9 donations totaling 80 acres were accepted for national-forest purposes. Of these, 9 acres were donated primarily for administrative sites. The remaining lands are suitable for timber growing and other national-forest purposes. Thirteen small tracts were purchased pursuant to the act of March 3, 1925, as amended, for administrative sites or as additions to existing administrative sites.

Boundary adjustments

Several boundary changes and adjustments were also made during the year to promote more effective administration. The Santa Rosa division of the Toiyabe National Forest in Nevada was transferred to the Humboldt National Forest by Public Land Order No. 819. The boundaries of the Shasta, Modoc, and Klamath National Forests in California were changed by interforest transfers by Public Land Order No. 804. Pursuant to section 11 of the Weeks law, five national forest purchase units in Ohio and four in Indiana were designated as the Wayne and Hoosier National Forests, respectively.

A total of 754 acres of public-domain land was added to the Ocala National Forest by Public Land Order No. 750. A tract of 2,319 acres was released from a military withdrawal and became part of the Boise National Forest in Idaho.

In Alaska, about 76,000 acres were eliminated from the Chugach National Forest by Public Land Order No. 797. These lands are by this action returned to the jurisdiction of the Bureau of Land Management for use and disposal under the public land laws. The purpose was to facilitate their classification and disposal under homestead and small tract laws to accommodate the accelerating demands for lands for farms and homes in the area.

COOPERATION IN STATE AND PRIVATE FORESTRY

Forest Management Assistance to Woodland Owners

Thirty-eight State forestry departments are cooperating with the Forest Service in providing technical assistance to owners of private forests and to small sawmill operators and other processors of primary forest products. The Cooperative Forest Management Act of 1950,

which replaced the Norris-Doxey Cooperative Farm Forestry Act on July 1, 1951, is the basis for this cooperative program.

The change-over to operation under the new act was made with no lost motion on the part of the foresters employed in the program, and with no interruption in handling landowner requests. Both farm and nonfarm owners of small forests are now advised and assisted in making simple plans for the management of their woodlands; in marking the trees in need of cutting; in measuring these trees and estimating their volume; in determining the proper cutting and logging methods to use in the harvesting operation; and in marketing the harvested products. In addition, many owners are advised on planting, thinning, and pruning operations, as well as on the protection of their forests from fire, insects, and disease.

The local forester who handles this cooperative forest management project work is called the service forester. In some localities, however, he is referred to as the farm forester, project forester, county forester, or district forester. In fiscal year 1952 some 250 of these technically trained State-employed foresters assisted 27,933 woodland owners to establish better management practices on 2,501,317 acres of woodland. Products harvested under their guidance amounted to 609,562,000 board feet of saw timber and other forest products. In addition 1,088 barrels of gum naval stores, 153,013 gallons of maple sirup, and quantities of Christmas trees, holly, nuts, tree seed, pine cones, and other miscellaneous products were harvested. The forest owners received a total of \$13,924,940 from the sale of these products.

Few of the cooperating States as yet have funds available to employ processor specialists to furnish technical assistance to small sawmill operators and to other processors of primary forest products. The service foresters in the course of their regular duties, however, assisted 6,617 forest products operators.

Cooperation with private foresters

For many owners, the woodland management job and its prospective returns are large enough to warrant the employment of private forestry consultants. Cooperation between the local Cooperative Forest Management service foresters and private consulting foresters is stressed. The State-employed service foresters referred 661 woodland owners with 429,563 acres of woodland to private practicing foresters. As more foresters enter private practice some of the tremendous burden on the CFM service foresters will be lightened. Some $4\frac{1}{4}$ million small owners, holding three-fourths of the private, commercially productive forest land in the United States, need varying amounts of on-the-ground technical forest management assistance if their woodlands are to be made and kept productive. In addition there are some 50,000 small sawmill operators and processors, many of whom could operate more efficiently if they could get technical guidance. Service to this small-operator group is just getting started by the cooperating States and Federal Government. Few private practicing foresters as yet have given attention to this field of work.

At the end of the fiscal year the service foresters had a backlog of 4,623 unfilled requests for technical assistance. Numerous project areas are still too big for adequate coverage by the foresters assigned to

them, and many woodland owners who requested service could not be reached. Large areas in a number of States have no service at all, because neither a public nor a private forester is available.

Farm Forestry Extension

The Extension Service of the Department of Agriculture cooperates with State agricultural extension services of the land-grant colleges in conducting extension forestry work under section 5 of the Clarke-McNary Act. The Forest Service also cooperates in this work as the subject-matter specialist agency. The program provides farm owners with educational assistance in woodland management, shelterbelt establishment, and in harvesting, marketing, and utilizing forest products.

Since woodlands in many States contribute a large part of the farm income, forestry must necessarily be considered in plans for farm management as developed by county agents and other agencies. Although conducted therefore as part of the agricultural extension program, the extension forestry program also is developed as a part of the broad State program for forestry, and is coordinated closely with the on-the-ground assistance available to woodland owners through State forestry departments in the cooperative forest management program.

The extension forestry program emphasizes the use of technical information and practices in the growing and management of timber as a crop on the farm. Every effort is made to build up the forestry knowledge of woodland owners so that they will have sufficient "know-how" for carrying on work in this field as they do with other crops. This is accomplished by providing owners with practical forestry information, conducting training schools, demonstrating forestry practices, and by conducting tours to forestry research units and to successful operations of individual owners. Forestry bulletins and the press and radio are used in calling attention to sound practices and the benefits to be gained by good forest management. County agents, county or community committees, and farmers serving as forestry leaders have important responsibilities in planning, organizing, and conducting extension forestry work.

Forty-five States and Puerto Rico last year employed one or more extension foresters to conduct the State programs. During the year, extension foresters gave intensive forestry training to county agents and local leaders who assumed a large share of the responsibility for conducting forestry educational activities in the counties. Also county committees and advisory groups in a number of States had part in discussing problems and shaping programs in tree planting, woodland management, marketing, timber estimating and appraisal, preservative treatment of fence posts, prevention of farm fires, and the production of naval stores and maple sirup.

Mechanized equipment

Farmers showed much interest in demonstrations of equipment for mechanizing farm forestry operations. Equipment demonstrated included tree-planting machines for reforesting idle lands and establishing windbreaks and shelterbelts, maple-tree tapping machines, and

wood-chipping machines for making mulch for orchards and gardens or bedding for use in poultry houses and dairy barns. Demonstrations of power saws and other logging equipment also attracted large groups. The fact that timber values have reached an all-time high has stimulated more interest in close utilization, and in applying better cutting practices with a view to harvesting timber crops at frequent intervals.

Chemical treatment of fence posts with preservatives has made notable progress. Demonstrations showing preservative processes, and permanent fence posts exhibits established at county fairs, are being used to tell the story of good fence-post treatment and proper fence construction.

Farm youths receive forestry instruction through forestry projects and other educational activities conducted as a part of the 4-H Club program. Forestry training camps for 4-H Club members have increased rapidly in number and in enrollment. Several State camps and numerous county camps were held last year. During the past year 169,029 4-H Club boys and girls received training in forestry, 214,373 in wildlife conservation, and 592,984 in fire and accident prevention.

Cooperative Tree Planting

Total production of trees for forest and windbreak planting by all nurseries—Federal, State, industrial, and commercial—was approximately 450 million in 1951. Of this quantity, 292 million trees were distributed to landowners by the States, with the cooperation of the Federal Government as authorized by section 4 of the Clarke-McNary Act. Although there have been other years of greater total production, this 292 million figure was the greatest “C-M 4” production yet achieved. It represented five-eighths of the nation’s total tree-planting accomplishment for the year.

State nursery expansion has increased production some 500 percent since 1944. Many of the States, however, were still unable to fill all orders for tree-planting stock, and few State forestry departments were able to push reforestation and shelterbelt planting aggressively, as they would like to do. Shortages occurred in 20 States, and may have amounted, all told, to as much as 60 million trees. To help meet the demand for trees, many of the State foresters traded stock among themselves, bought stock as available from commercial nurseries, and made long-term contracts for future delivery with other State, Federal, and commercial nurseries.

Further State nursery expansion is under way. Seven of the States are building new nurseries, and twelve are expanding existing nurseries. When these are completed, the total capacity of State forest-tree nurseries will approximate 500 million trees a year, but it will still be small when measured against the millions of acres of denuded or understocked forest land in the United States that need to be reforested.

Cooperative Fire Control on State and Private Forest Lands

Under authorization of the Clarke-McNary Act the Forest Service continued cooperation last year with 43 States and Hawaii for the protection of State and privately owned lands from fire. This was

the forty-first year of such cooperation. It was first started in 1911 under authorization of the Weeks law. The program was greatly broadened and strengthened by the Clarke-McNary Act of 1924.

For State and private forces as well as for those on the national forests, the fire season in Oregon, Washington, and parts of California and Idaho in 1951 was one of the most severe on record. Missouri, Louisiana, Mississippi, and Alabama also had unusually difficult seasons. These were the "hot spots" in the cooperative protection program during the year.

A total of 97,230 fires was reported on State and private protected lands. The States estimated that another 58,222 fires occurred on unprotected areas. The total of 155,452 fires was below the 199,982 total for the preceding year.

Wild fires on protected State and private forest lands burned 3,055,505 acres, or 0.84 percent of the area protected. On unprotected lands, according to the best estimates available, 7,254,666 acres burned, or 11.46 percent of the total unprotected area.

In spite of the unusually bad fire weather in several States, the State protection agencies held the Nation-wide average of area burned per fire to 31.4 acres. The 1950 average was 35.3 acres.

Large area still unprotected

Of the 426,694,000 acres of State and private forest and watershed lands needing protection in the United States, 363,414,000 acres are now under organized protection, leaving 63,280,000 without the benefit of any organized protection efforts. Cooperative protection was extended to an additional 2,850,000 acres during the year. But in many States the protection in organized areas is still spread much too thin to cope successfully with a really serious or prolonged fire season. It needs to be strengthened by more well-trained men and more equipment.

For the fiscal year 1952 Congress made \$9,423,500 available for Federal participation in the cooperative protection program. Latest expenditure records available are for the fiscal year 1951 during which the States and private owners spent \$24,163,877 for the program, and the Federal Government \$9,480,000, or a total of \$33,643,877. In addition to this amount used in the "C-M 2" program, lumber companies and large timber owners spent over \$8,750,000 for special fire-control equipment, improvements, and services.

Ninety-eight percent of all the fires in 1951 were man-caused, and therefore preventable. Of these man-caused fires, 77 percent occurred in the 11 Southern States. Forestry agencies in the Southern States are giving increased study to the reason behind the cause of these numerous man-caused fires and are endeavoring to devise successful means of reducing their number.

Naval Stores Conservation Program

The naval stores conservation program provides assistance to gum turpentine farmers who follow conservation practices in the Southeastern States of North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi. It is authorized by the Soil Conservation and Domestic Allotment Act and is administered by the Forest Service for the Production and Marketing Administration.

The active naval stores producing area is a belt from 50 to 100 miles wide extending along the Atlantic seaboard and the Gulf of Mexico. It comprises a gross area of about 50 million acres. In this area there are more than 8,000 producers, working about 63 million longleaf and slash pine trees for the production of turpentine and rosin, the two main products known as naval stores. Georgia has 87 percent of the producers and 75 percent of the timber worked. Florida has 6 percent of the producers and 17 percent of timber, Alabama 5 percent of producers and 5 percent of timber. The few score remaining producers are in Mississippi, North Carolina, and South Carolina.

The program is designed to encourage producers to adopt and carry out good naval stores and forestry practices, adapted to the conditions and timber stands on their properties. The 1951-52 program provided payments at specified rates per face on tracts where trees were worked to a minimum diameter of 9, 10, or 11 inches. A payment was provided for selective cupping where tracts having a minimum of 50 trees per acre were cupped in a manner that would result in leaving as many trees in the stand uncupped as those which were cupped. A payment also was provided for restricted cupping.

In addition to following the practices for which payments are made, a producer in order to receive any payment had to follow good timber-cutting practices and cooperate with the State's fire prevention and suppression programs.

In the 1951-52 season, 3,322 producers participated in the program with 49 million trees. Comparable figures for the preceding year were 3,069 producers and 51 million trees.

The most outstanding recent improvement in working trees for naval stores has been the use of the bark hack with sulfuric acid solution sprayed on the streak to stimulate and prolong the flow of gum. This technique, developed by the Forest Service, will produce as much gum from half as many streaks as were required with the old wood-chipping method. The method therefore saves much labor. Trees can be worked longer, and because only the bark is removed, the tree can be utilized for wood products with little or none of the loss that occurred from deeply scarred faces when the old wood-chipping system was used.

Promotion of chemical stimulation by the naval stores conservation program foresters has resulted in adoption of the method by an increasing number of producers. In 1949, 5 percent of the producers used the treatment on 6 percent of the faces. In 1950, 9 percent used it on 17 percent of the faces. In 1951, 21 percent of all gum turpentine producers in the naval stores belt used chemical stimulation on 29 percent of all faces.

The foresters assigned to field administration of the program give much effort to promoting good timber management generally—not only for the production of naval stores but for all forest products.

Pest Control

Representatives of forestry, industry, and conservation interests were asked by the Secretary of Agriculture in 1952 to serve as a committee of consultants on questions arising in connection with the Department's activities under terms of the Forest Pest Control Act of

1947. This act authorizes a broad program for the control of destructive insects and diseases attacking the forests. Members of the advisory group, and the organizations represented, are:

A. H. McAndrews, Syracuse, N. Y. (Forestry School Executives.)
Ernest L. Kolbe, Portland, Oreg. (Forest Industries Council.)
Fred H. Lang, Little Rock, Ark. (Association of State Foresters.)
D. Clark Everest, Rothchild, Wis. (American Forestry Association.)
Walter Damtoft, Canton, N. C. (Society of American Foresters.)
Fred W. Roewekamp, Los Angeles, Calif. (Association of Park Executives.)

Coordination of Departmental Forestry Activities

The Secretary of Agriculture's Memorandum No. 1278 marked a significant advance in achieving coordination of the Department's farm forestry activities. In one section of this memorandum the Forest Service was assigned major responsibility for farm forestry work.

During the past year three agencies—the Forest Service, Soil Conservation Service, and Production and Marketing Administration—drew up an agreement detailing their responsibilities under the Secretary's memorandum. For the first time the Forest Service has actively participated with the Production and Marketing Administration in developing the forestry practices to be included in the agricultural conservation program and the rates of payment for these practices. The Soil Conservation Service and the Production and Marketing Administration have been of considerable assistance to the State forestry agencies in interesting farmers in good woodland management. On their part the State Forestry agencies, which are the local administrators of the cooperative Forest Service-State programs, have been a major factor in achieving the coordination of farm forestry work.

In general, this cooperation has resulted in substantial progress toward greater recognition of the important place of forestry in farm conservation plans, better technical formulation of forestry practices in State farm conservation programs, and increased interest of farmers in forestry practices under the agricultural conservation program.

RESEARCH

Research continues to be directed toward the development of new scientific facts as a basis for more efficient management, protection and utilization of the renewable resources of timber, range, and water. This research is carried on by the Forest Service at 11 regional experiment stations in the continental United States; at a tropical forestry station in Puerto Rico, at a research center in Alaska, and at the Forest Products Laboratory at Madison, Wis. Much of the work is concentrated on experimental forests and ranges. In many cases it has been strengthened and expanded by cooperative participation on the part of other Federal, State, and private agencies and individuals.

Special emphasis has been given to these cooperative and coordinating phases of the research program during the past year. A National Advisory Committee on Forest Research was appointed. This Committee, functioning within the framework of the advisory

committee system developed by the Agricultural Research Administration, will serve as a valuable aid and guide in developing a realistic and balanced research program.

As a result of these and other favorable circumstances, much that is worth while has been done. In the following pages are examples of some accomplishments of the past year in research dealing with the management and protection of forest and range lands, and with the utilization of forest products.

Forest Management

New check list of trees

A job completed in 1952 was the compilation of a new Check List of Native and Naturalized Trees of the United States. This publication will give the accepted scientific names, common names, and geographic ranges of all species of trees in this country. Trees of Alaska and Canada also are included. More than 1,000 species, varieties, and recognized hybrids are listed. Notes and references on nomenclature are included; and for each species various common names in local use other than the approved common name are given. Also included are a botanical index of plant families and genera, and a list of tree names used in the lumber trade. The new check list will be published as Agriculture Handbook No. 41 of the Department of Agriculture. It is expected to be off the press early in 1953.

Renewing forests

Seeds of all important Northwest tree species can be stored for at least 6 years without loss of viability if held at temperatures of freezing or lower. This information comes from a cooperative study by the Pacific Northwest Station and the Boyce Thompson Institute. Reforestation has become a large and growing undertaking in the Northwest region, with well over 300,000 acres planted by all agencies to date. Since good seed crops do not occur every year, large quantities of tree seed must be stored in order to assure adequate supplies for nursery and direct seeding operations.

That disking can provide adequate stand regeneration of certain Lake States pulpwoods at a cost only 20 to 25 percent of the cost of planting was shown by a series of tests by the regional forest experiment station. Success requires an adequate supply of viable seed, 40 to 60 percent of the surface in recently exposed mineral soil, and abundant rainfall in the first two growing seasons following treatment.

Small-scale tests made by the Rocky Mountain Station have indicated that the lodgepole pine and spruce-fir forests of this region can be regenerated satisfactorily by alternate-strip clear cutting. The merits and defects of the method in actual practice are now being tested in a large-scale pilot plant experiment involving some 6½ million board feet of merchantable timber.

In Puerto Rico, observations in plantations of broadleaf mahogany indicate that on good sites this species may prove highly productive. Fifteen-year-old plantations have an average diameter of 6 inches and are growing at the rate of 150 cubic feet per acre. The apparent success of these plantations has been the basis for a recommendation of underplanting of this species on 500 additional acres.

A series of reports was completed by the Central States Station which describe strip-mine conditions and give overburden analyses for the eight coal-mining districts of Ohio. They make available for ready use by forest-land owners and other agencies concerned with rehabilitation of stripped lands in Ohio, summaries of reconnaissance and stratigraphic (arrangement of strata) data. With few exceptions, the most practical use for these lands is growing trees to improve soil conditions and to produce forest products.

Developing superior trees

At the Institute of Forest Genetics in California, Forest Service researchers made important progress on the tree-breeding program. For the first time a sufficient number (21,500) of hybrid pine seedlings has been produced to permit the establishment of a pilot plantation. This plantation included five of the most promising hybrids developed at the institute to date. All but one are crosses with ponderosa pine, the predominant species of pine in the West. Since ponderosa occupies more area than all other western pines, any hybrid improvement is of tremendous significance to western forestry.

Seed farms—the source of hybrid seed—are no longer a matter of wishful thinking. One such farm developed by the institute produced 55,000 sound seed during the past year. This amount of seed is sufficient to reforest 165 acres to hybrid pine at the rate of 1 hybrid to 4 trees from ordinary stock. In this method of mixed planting, the trees from ordinary stock ultimately become thinnings and the hybrids become the final crop.

The first step in shortening the period from the development of a hybrid to the production of hybrid seed has been made. It was accomplished by a grafting technique which permits the union of hybrid seedlings to mature trees. Thus far male flowers have been successfully produced by the grafting procedure. As soon as such graftings result in the production of female flowers the process will be complete. In the meantime, mature trees that are naturally heavy producers of seed are being identified for understock—the trees to which hybrid seedlings are to be grafted.

Still another technique that will speed up hybrid seed production has been developed. It makes possible the immediate germination of seed after maturation. From seed collected in September it is now possible to produce seedlings in December equal to planted stock 1 year old. A chilling treatment now under study is also expected to make it possible to induce a second year's growth and thereby obtain 2 years' growth in 1. Hybrid seedling material for grafting purposes can thus be produced in record time.

A South-wide study of geographic strains of the four major southern pines was started in 1951. It is being spearheaded by the Southern Forest Experiment Station and participated in by a large number of forestry organizations, including the Southeastern Station. The tree planting program in the South, and the short rotation for merchantable products promise to make tree improvement through selection and breeding of superior types a fruitful line of investigation.

Tending existing forests

Bigtooth aspen stands should be harvested by age 50 in northeastern Iowa, according to studies by the Central States Forest Experiment Station. Beyond this age, deterioration and losses become excessive. In recent years a good market has developed in this area for aspen for lumber and veneer and its sale value has increased.

Species suitability is being determined for problem areas in the Northeast. For converting lands now occupied by scrub oak into valuable forests, in the Pocono section of Pennsylvania, red pine is proving to be the best all-around species. On cut-over and burned spruce lands in West Virginia, red pine is again most successful in competing with herbaceous growth, while red spruce can most successfully compete with overtopping shrubs.

The role of fire as a silvicultural agent in the regeneration of pitch pine in southern New Jersey is now well established as a result of studies dating back to 1936 by the Northeastern Forest Experiment Station. Controlled light winter burning helps check hardwoods and provide a favorable seedbed for the pine. In this area as in many other locations where pine is found, the natural succession is to hardwoods. Special measures, of which prescribed burning is only one of several possibilities being tested, are necessary to perpetuate the generally preferred pine.

In the South, hardwood control has now been performed on 292,000 acres of privately owned timberland. Participated in by 27 different companies, this work was designed to favor the growth of the more valuable southern pines and was accomplished chiefly in the 2-year period preceding June 1951. The techniques employed in this comparatively new silvicultural practice stem in large part from research carried on at the Southeastern and Southern Forest Experiment Stations.

A new source of pulpwood is developing in the Lake States in the form of thinnings from almost 1,000,000 acres of red pine and jack pine plantations. To meet increasing demands for tested methods of plantation culture, the Lake States Forest Experiment Station has a number of studies under way. Current emphasis is in lower Michigan, where most of the older Lake States plantations are located.

Spruce trees were pruned to 18 feet at an average cost of less than 15 cents per tree, in a cooperative study by the Northeastern Station and the University of Maine. Pruning at this cost should be a good investment, considering the difference in value between knotty and clear lumber. Cost studies in the Pacific Northwest have demonstrated that crop trees can be pruned to a height of 18 feet in a 40-year-old stand of Douglas-fir for about 25 cents per tree. Open-grown longleaf pine trees in central Louisiana were pruned to 17 feet at a cost of 4 cents per 4-inch tree (diameter breast high) or 8 cents for an 8-inch tree.

Gross volume growth per acre in young ponderosa pine stands in the Southwest is rarely increased through thinning. This conclusion is emerging from 46 study plots established at 6 different locations between 1924 and 1935. As markets develop for small products in the area, however, it still may be possible to get the benefits of increased diameter growth of reserved crop trees and improvement in quality of wood which result from early thinning.

In Puerto Rico, it was found that light improvement cuttings in rain forest result in adequate natural reproduction of some of the better species, making unnecessary the introduction of better species by underplanting. Experimental improvement cuttings in rain forest have also shown that some of the aggressive weed species may be eliminated simply by girdling without the use of poisons if a fairly dense stand is left.

Aerial photographs have been used to locate all remaining relics of virgin forest in Puerto Rico to make possible complete descriptions of these forests before they disappear.

Applying technical principles to forest management

The forests of southeastern Alaska are "climax" forests, that is, in the final, stabilized stage of their natural development. A system of classification for this type of Alaska forest was completed during the year to meet partially the growing need for forest-management knowledge in connection with the expanding use of Alaska's timber. The characteristics of the new classes are distinct as to volumes attained, the proportion of species, the number of logs produced, the number of culls, and gross growth. The classification system will serve to describe a stand prior to logging in sufficient detail that future second growth on the same area can be related to it.

A vigor classification to aid timber markers is now available for mature western white pine. Conducted jointly by the Northern Rocky Mountain Forest and Range Experiment Station and the Bureau of Entomology and Plant Quarantine, work on this project started in 1941. The ability of mature trees to grow and to resist destruction by damaging agents can be predicted with a fair degree of accuracy by the classification system.

A 1951 survey in the Upper Peninsula of Michigan assembled data from 2,600 plots distributed over 65 swamp-forest cuttings. The findings will be helpful in directing future research in the management of the potentially valuable swamp forests. Cooperating with the Lake States Station in this project were private companies, the Michigan Department of Conservation, and local national forests.

Efforts to check the decline of the coffee industry, which by the production of coffee beneath forest shade protects the soil and water resources of 10 percent of the land surface of Puerto Rico, are meeting with some success. A joint study of the variability of coffee yields in which the Tropical Forest Experiment Station is participating has shown that overhead shade intensity is the environmental factor most clearly related to yield of the coffee tree. This finding provides a lead for corrective measures in which forestry will play a prominent part.

An annual growth rate of 600 board feet per acre, worth at least \$12 at current stumpage prices, has been maintained for 13 years following a 1938 thinning in a 100-year-old stand of Douglas-fir. Furthermore, windfall losses following this cutting on the Wind River Experimental Forest in Washington have been negligible. By 1951 the volume of 7,800 board feet per acre removed in the thinning had been entirely replaced through growth, and another cut of approximately the same volume was made.

Naval stores

Chemical pine-gum-stimulation methods, pioneered by the Forest Service at its Olustee Experimental Forest in north Florida, conserved one-quarter million man-days of labor in 1951 with an estimated saving of \$1 million to the industry. Five years' trial shows that treatment with 50-percent sulfuric acid produces greater yields from both slash and longleaf pine than the 40- and 60-percent concentrations originally recommended. The 50-percent concentration is now standard for the gum naval-stores industry and was the only concentration in use last year.

Yields were found to be 12 and 36 percent greater for slash pine and longleaf pine, respectively, when tins (gutters) were nailed on over smooth bark instead of being inserted in the tree with a broad ax, the usual method. The test was conducted on a biweekly schedule of bark chipping and acid application on virgin faces in slash pine, and cutting of yearling faces in longleaf pine. A similar increase in yield occurred in the virgin year in longleaf pine.

Pilot-plant studies in integration of gum production and agriculture on farms revealed some very encouraging possibilities. Under favorable conditions and 1951 price levels, a gum farmer netted 25 cents per tree for the first year of work.

Research in Forest Fire Control

Through its program of forest-fire research, the Forest Service is endeavoring to help reduce the Nation's costs and losses from forest fires, brush fires, and grass fires by the application of modern technology to their control. The technical problems in forest-fire control involve human and other aspects of preventing fires; they concern the weather, the great variety of natural fuels, and the peculiarities of fire behavior. They concern also improvement in the methods, organization, and techniques required to fight fires successfully. Increased knowledge in these fields will make it possible to stretch the fire-control dollar and accomplish more with it.

In addition to the work on research projects the Forest Service prepared some 25 reports or bulletins to make available new information that can be helpful to fire fighters. One of these reports dealt with a 4-year statistical study of 36,000 forest fires in the northern Rocky Mountain region. This report traces the trends that have occurred in the fire problems of that part of the country. It will help greatly in charting the future fire-control program for the region.

A second research publication, that has been in great demand both in this country and in foreign countries, presents the best knowledge developed to date on the behavior of forest fires under different combinations of weather, topography, and fuels. Although this report is based mainly on studies and observations in the northern Rocky Mountain region, most of the information it makes available is significant wherever forest fires are a problem.

Through cooperative arrangements, a study was begun in north Idaho and Montana on the troublesome problem of how to reduce the number of forest fires caused by lightning. With the help of Forest Service fire look-outs, Vincent Schaefer of the General Electric Co., who has been conducting studies in cloud physics, undertook to obtain

time-lapse motion pictures of the build-up of mountain lightning storms. This work may help to determine the possibility of using cloud-seeding techniques to dissipate lightning-bearing clouds.

Range Research

The range-research program of the Forest Service is emphasizing the development of practices that will insure greater values from the country's range resources and so increase livestock production. This program has in mind also the developing of suitable procedures for reseeding ranges to increase forage production and give better livestock gains, and economical methods for reducing undesirable plants. The need for producing more meat for the Nation's growing demands stresses the importance of such developments and their early application.

Forest grazing in the South and Southeast

Liquidation of virgin timber in the southern and southeastern States has left millions of acres of clear cut or very poorly stocked forest land. Much of this land has great potentialities for the production of range forage as well as for future timber production.

Range research conducted in several Southern States has shown that such areas can be profitably utilized for livestock production while being put back into timber production, if livestock grazing and timber growth are closely correlated. In southwest Louisiana, loblolly and longleaf-pine plantations have a grazing capacity of 1 cow-month per acre for a 4-month season, March to June. Grazing capacity declines as the trees grow but rises again when the first thinning is made when the trees are about 15 years old. Additional thinnings at 5-year intervals will salvage weakened and low-grade trees and at the same time enhance the grazing capacity.

Livestock production in pond pine forests of North Carolina has proved feasible and practicable. Cane and palatable browse species on pond pine ranges have a sustained grazing capacity of between one-third and one-half cow-month per acre during the summer season. Establishment and growth of pond pine seedlings are favored by grazing. Disturbance of surface litter by grazing animals enhances the chances for pine seed to reach a suitable spot for germination, and the reduction in competition from other vegetation brought about by grazing is reflected in increased pine seedling growth. Grazing also protects the seedlings from fire damage. Too heavy or unregulated grazing, however, is detrimental both to the forage plants and to the pine seedlings.

Research indicates that wiregrass ranges in the longleaf-slash pine belt in Georgia and northern Florida also can be managed to produce more beef cattle and timber. An allowance of seven acres per cow of upland range freshly burned by carefully conducted prescribed burning, plus 14 acres of unburned upland and 3 to 4 acres of swamp has proved sufficient to carry a cow during spring and summer. Concentrated protein feeds are required to supplement the range forage during the balance of the year. Grazing of the freshly burned-over upland areas does not affect the establishment of pine seedlings. Likewise, it was found that such burning was not detrimental to established

longleaf pine seedlings, although it does kill most of the small slash pine seedlings. Prescribed burning plus regulated grazing in longleaf-slash pine forest lands reduces the hazard of wildfires, increases the production of livestock generally, and permits satisfactory regeneration and growth of pine seedlings.

Utilization of northern Great Plains ranges

Studies conducted on northern Great Plains ranges grazed by cattle near Miles City, Mont., have shown that grazing under moderate stocking varies from year to year, by species, by range subtypes, and with distance from available water. Utilization also varies with stocking and therefore is a good indicator of the rate or level of stocking on a given range. The percentage of plants of important species that is grazed is a good guide to range utilization. Recommended grazing intensities for most summer-range types studied call for utilization of not more than 55 percent of the bluestem wheatgrass plants, 40 to 45 percent of the blue grama plants, 55 to 60 percent of the needle-and-thread plants, 50 to 55 percent of the buffalograss plants, and 50 percent of the threadleaf sedge plants. Slightly heavier grazing of bluestem wheatgrass plants (65 to 75 percent) is permissible on winter ranges and on bottom land types. Winter and summer ranges should be fenced separately and grazed only during the appropriate season.

Reseeding of range land in Montana

Recommended guides to what, where, when, and how to reseed Montana range lands were brought up to date by the Forest Service this year in a revised edition of Farmers' Bulletin No. 1924. Plant species recommended are grouped according to their suitability for the plains, mountain, foothill, and valley ranges. Late fall seeding is ordinarily superior to spring seeding for all species except blue grama, which is best seeded in midspring. Seed of forage species must be covered to insure planting success. Drilling plants the seed to best advantage under most conditions. Dense stands of cheatgrass or other undesirable cool-weather plants must be removed to reduce competition for soil moisture. These recommendations result from several years of research on reseeding techniques. They should furnish the basis for reseeding 3 to 4 million acres of range lands in Montana and adjacent States that are still producing below their potential.

Grazing on reseeded ranges

That moderate or light stocking on range reseeded to crested wheatgrass produces better cattle gains than heavy stocking is indicated by cooperative reseeding and spring grazing studies at Benmore, Utah. For the first 4 years, heavy stocking which utilized 80 percent of the herbage resulted in a gain of 2.05 pounds per day. Moderate stocking which utilized 65 percent of the herbage resulted in 2.70 pounds daily gain; and light stocking, utilizing 50 percent of the herbage, resulted in 2.86 pounds gain. Sagebrush and rabbitbrush are invading the heavily stocked areas. Moderate stocking also gave better protection to the soil than heavy stocking. Movement of the soil, both during heavy rains and during strong winds when the soil was dry, was noticeable on heavily stocked range, but did not occur on the moderately stocked range. Heavy stocking left insufficient protective cover.

Yearling heifers have continued to make good gains on reseeded range at the Manitou Experimental Forest in Colorado, in spite of the dry years in 1950 and 1951. Because of subnormal rainfall the yield of grass on reseeded range areas in 1951 was only one-fifth that of 1948, a year of abundant rainfall. Because of poor growth, the grazing season was also reduced from 176 days in 1948 to 54 days in 1951. Heifers grazing three reseeded experimental areas gained an average of 43 pounds per acre, about half as much as the 81 pounds gained in 1948. But gains on good unseeded range during a similar period in 1951 were only 8.3 pounds per acre. Daily gains during the shortened season on the reseeded range were high, averaging 2.1 pounds per day as compared to 2.0 pounds per day during the comparable season in 1948.

Control of undesirable plants

Studies over a 12-year period in southern Idaho show that planned and controlled burning of big sagebrush can increase forage for livestock. Twelve years after burning, a test area had 98 percent more grazing capacity than adjacent unburned range. Desirable grasses, especially thickspike wheatgrass, provided most of the increase. Big sagebrush, which is unable to sprout, and other woody plants were greatly reduced by the fire, as were the fine bunchgrasses such as Idaho fescue and bluegrass. Bitterbrush was also greatly reduced but recovered part of the loss. In addition to increasing the grazing capacity, removal of the sagebrush by burning made easier the handling of sheep and reduced wool and lamb losses.

Chemical foliage sprays also have proved successful in reducing stands of big sagebrush. In California the butyl ester of 2,4-D resulted in a complete kill when applied on June 30. Time of application is important—the same treatment applied 1 month later produced only a 92-percent kill. The native grass yields increased from 55 pounds per acre before spraying to 589 pounds per acre on sprayed areas where most of the sagebrush was killed.

Near Kamas, Utah, 2,4-D killed 97 percent of the big sagebrush and 40 to 73 percent of the rabbitbrush. Grass production was 180 pounds per acre on the untreated area and 450 to 600 pounds per acre on the sprayed areas. Another area in Utah (Moon Canyon) which had been seeded to crested wheatgrass was invaded by sagebrush and rabbitbrush. Spraying with the ester form of 2,4-D gave a 94-percent sagebrush kill. This kill plus a 91-percent kill of rubber rabbitbrush increased grass production on the range which had been sprayed from 2,350 pounds per acre to 5,700 pounds.

In Wyoming the ester form of 2,4-D and 2,4,5-T both gave good sagebrush kills, 2,4,5-T being slightly superior. Spraying in the early stages of seasonal growth gave best sagebrush kills.

The increased density and vigor of the forage plants on sprayed areas gives better soil protection and furnishes more forage for livestock.

Wyethia, a vigorous perennial weed that is native to mountain summer ranges throughout the West, has increased on many areas, preventing the establishment of good forage plants and causing a loss of grazing capacities. This low-value, undesirable plant prefers moist,

heavy soils and consequently has taken over some of the most productive range sites. Research conducted in Montana and Idaho has proved the practicability of removing this plant from the range by chemical sprays. A solution of 2,4-D in water removed 95 percent or more of the *Wyethia* when applied at the mid- or late-bloom stage. Removal of dense *Wyethia* stands must be followed immediately by reseeding of forage species to prevent soil losses through erosion and reinvasion of the sprayed areas by *Wyethia*.

Improving brush ranges in California

Successful conversion of dense brush areas to productive range in the foothills of California requires careful burning and successful reseeding, research studies show. In the woodland-shrub type where dense brush previously prevailed, good stands of perennial grasses and some legumes have been obtained by broadcast seeding in the fall, following controlled burning on the better sites. Annuals were seeded on the generally poorer sites. On woodland-shrub areas with an open stand of brush, where there was a good stand of annual grasses before burning, broadcast reseeding was not necessary, as the grass came back quickly. In such situations spot seeding was found to be worth while in local areas of brush thickets.

These studies are carried on with special attention to watershed values. Studies on selected areas have indicated that the greatest effects, in terms of soil losses and down-stream sedimentation, occur on the steeper slopes and less fertile soils. On the gentler slopes and more fertile soils, reseeded burns produce less surface runoff and soil losses, and more forage. Because soil and slope conditions vary so greatly, it is essential that the likelihood of successful conversion to grass and of minimum watershed disturbances be determined in advance wherever possible, in order to avoid unnecessary waste of labor and investment.

Further joint investigations have been started by the Forest Service, the University of California, and the State of California. These will include (1) the classification of brush areas of varying degrees of suitability for conversion to grass, and (2) studies and tests to determine the effects of brush burning on surface runoff and erosion on a wide variety of soils.

It is believed that these investigations will enable livestock operators to save thousands of dollars by concentrating their efforts in localities where the opportunities for establishing grass are likely to be most successful, and where floods, erosion, and sedimentation are least likely to be accelerated.

Forest and Range Influences

Our knowledge of the role of land and its use by man on the control of floods and the improvement of water supplies continues to increase. The Forest Service has gone far enough in its watershed research and flood-control investigations to confirm the principle that the conserving and controlling of the potent water resources of this Nation depend to a large degree on our respect for the land and the care with which we use it.

A highly significant feature of the progress in watershed management, both in research and on the action front, has been the growth of

cooperative activities carried on by a large number of individuals and groups, both in and out of Government. Notable among cooperative groups are the National Association of Soil Conservation Districts, and the American Watershed Council. The latter is a clearing house for many of the 250 or more voluntary community, State, or regional associations organized to promote and expedite joint efforts to place their watersheds in good condition. As these associations come to closer grips with their problems, they are coming to rely increasingly upon the findings from watershed management research on forest and range lands.

Timber harvest methods affect water values

The growing consciousness of water values emphasizes further the necessity for harvesting timber on both public and private lands with due regard to soil and stream flow stability. This trend is accentuated by the rapid acceleration and extension of timber cutting to additional areas on many critical watersheds. It is well known that improperly built and maintained logging roads and skid trails produce soil erosion and muddy runoff. Not so generally known or appreciated are the effects of the methods of cutting or ability of the soil to store water. Studies in the deciduous forests of New York and New England show that repeated clear cutting is followed by a marked decrease in the depth of the humus layer and, in turn, a decrease in its water storage capacity. The humus and top soil layer of well-stocked ungrazed mature timber stands were found to contain two-tenths of an inch more water when the soil was saturated than did the young, understocked stands resulting from clear cutting, and about a half-inch more water at saturation than grazed, uneven-aged stands. Careful forest practices can reduce flood runoff appreciably, especially on shallow soils, by increasing the storage capacity of the soil.

Investigations on the Allegheny Plateau of West Virginia show that erosion and surface runoff caused by log skidding can be greatly reduced by placing simple water bars at calculated intervals along skid roads immediately after logging. Water and soil losses can be reduced still further by so locating and designing skid trails and logging roads as to provide for more effective disposal of runoff water. One important factor in stabilizing the soil is the early development of a plant cover such as weeds, grasses, etc., on the skid roads after the logging is completed.

The relationship of logging to stream flow continues to receive attention in investigations in the Southern Appalachian hardwood forests. Results so far indicate the desirability of a threefold classification of merchantable timber areas: (1) Areas which should not be logged at all under present known methods; (2) areas on which special precautions should be taken in log-road construction and skidding to prevent excessive erosion and runoff; and (3) areas where present provisions for logging appear satisfactory from a watershed point of view. The last classification includes mainly national forest lands where watershed values are already receiving considerable recognition. On many other areas, however, provisions for minimizing watershed damage by logging are still largely lacking. In general, on a Nation-wide basis, the merchantable timber areas which should receive special consideration, irrespective of ownership, would include

(1) slopes and erodible soils subject to heavy rainfall, (2) similar slopes and soils subject to heavy accumulations of snow and excessive spring rains, (3) drier areas, as in the ponderosa pine regions, which are subject to intense summer rainfall.

Special management practices increase water supplies

Previous annual reports have described the progress of research at the Fraser Experimental Forest in Colorado to determine the effects of timber cutting on water yield in areas where most of the precipitation comes as snow. A complete watershed area of 700 acres has now been scheduled for cutting by the strip method over a period of years in order to measure the effects on actual stream flow. Logging roads have already been constructed along the contour and the effects of the openings thus far created are now being investigated to determine increased snow catch, changes in amount of moisture entering the soil, and changes in volume and turbidity of stream flow. Actual timber harvesting will commence after the effects of the roads themselves have been measured. A station publication is being prepared to give results to date of the work at the Fraser Experimental Forest, thus permitting interested people to obtain authoritative information on the findings so far obtained and on the present status of this important research project.

One significant observation that has come out of the study recently is that the maximum accumulation of snow (in terms of water content) is found within the upper portion of the timbered areas rather than on the open spaces above timber line. This finding emphasizes the value of properly designed cutting operations in the coniferous forests at the higher elevations of the Rocky Mountains.

Range land use

Results of investigations of the effects of various intensities of grazing on soil and water losses for three of the major types of livestock range along the eastern slope of the Rocky Mountains in Colorado have permitted a determination of grazing levels which will most nearly assure adequate watershed conditions. These standards, based upon the retention of minimum quantities of cover and litter, expressed in pounds per acre, take into account the variations in rates of water intake and the depth and erodibility of the soils.

Investigations on semiarid range lands in Arizona show that under the climatic and soil conditions which prevail, the quantity of vegetation present makes no significant difference in the yield of water from these areas. Where vegetation is sparse, and especially where the soil is shallow, the savings in water used by grasses are offset by the increased evaporation losses. However, a sparse vegetation gives inadequate protection against accelerated soil erosion and the sedimentation of reservoirs and valley agricultural lands following torrential rains. The studies indicate that protection of the soil by an adequate vegetative cover will in no way deprive downstream water users of any more water than if the vegetation were insufficient to protect the soil.

Growing knowledge of plant-soil-water relations

Studies of variations in the use and storage of soil moisture by forest and other native vegetation in the South Carolina Piedmont confirm

earlier findings on the relation of roots to water yield and flood control, where soils are deep and the climate is wet. For example, the soil under a young stand of loblolly pine was able to store 5.18 inches of rain, and a 40-year-old pine stand 3.51 inches, whereas a field covered with shallow-rooted broomsedge was able to store only 0.11 inch, and a barren area only 0.14 inch. Most of the spring rains ran rapidly off the bare areas and shallow-rooted broomsedge, whereas no surface run-off whatever came from the deep-rooted forest plots.

Experiments in open stands in the Wasatch Mountains of Utah showed that removal of the deep-rooted aspen, but without disturbance of herbaceous cover beneath, reduced transpiration losses to a point where 4 inches more water was made available for stream flow. When the herbaceous cover was also removed, an additional 4 inches of water was made available, but at a cost of 12 tons of soil loss per acre, thus foreboding serious flood and debris hazards to downstream communities.

The influence of roots on the intake and storage of moisture from rains is further substantiated by studies in southeastern Ohio. It was found that in the plots studied the vertical channels in the soil created by living and decaying root systems under a stand of white oak trees amounted to 4,000 per acre down to a depth of 50 inches.

Altogether, it is expected that these studies will throw light on the systems of forest management that will be most likely to influence stream flow in accordance with given objectives of increased water yield or decreased flood peaks, as the case may be.

Expanding cooperative activities and assistance

During the past year the growing interest in basic watershed research was reflected in the release of Senate Document No. 98, Soil and Water Problems and Research Needs of the West. Advice and assistance were furnished to organizations closely concerned with watershed matters such as the American Watershed Council and National Association of Soil Conservation Districts. Special assistance was also given to the Corps of Engineers on soil-moisture problems, and to the State Department (and through it to the United Nations) by representation on an Interagency Committee on International Water Policy. The Geological Survey is now including information in its water bulletins on frost conditions gathered by the Forest Service in the Northeastern States. This information is permitting a more accurate appraisal of flood possibilities since it distinguishes between those types of frost likely to cause rapid flood runoff during the spring snow-melt season and those not likely to do so. It is also calling attention to the importance of selective cutting practices and protection of forest lands from fire and grazing. Forest fires and woods grazing in the Northeast cause conditions that contribute to the formation of types of frost which favor floods.

Forest Economics

Information on the Nation's timber supplies, on the quantities and kinds of wood used in civilian and defense activities, and on prospective future requirements for timber products in relation to prospective timber growth is increasingly needed both for public and private timber-production plans and programs. The Forest Service, through

the Forest Survey authorized by the McSweeney-McNary Act of 1928, collects and interprets basic forestry and economic information bearing on these questions of timber supply and demand.

About 434 million of the 620 million acres of forest land in the United States have been covered by initial forest surveys since 1928. These surveys have obtained specific facts about forest-land areas, timber volumes, and timber growth and drain. About 135 million acres covered prior to 1940 have also been resurveyed to determine the changes resulting from growth on the one hand and drain from logging, fire, insects, and disease on the other.

During fiscal year 1952 initial field surveys covered about 12 million acres of forest land in California, Idaho, New York, Pennsylvania, Maryland, and Ohio. Resurveys of areas previously covered in Washington, Minnesota, Wisconsin, Michigan, Alabama, Georgia, and North Carolina totaled about 20 million acres. Substantial financial or other assistance was contributed by cooperating public and private agencies in 10 of these States. Analytical reports on forest resources were completed for the States of Montana and Florida. Statistical reports were issued for Vermont and Indiana and parts of California, Oregon, Minnesota, New York, and Tennessee.

Equipment requirements study

A national-defense project completed during the year was a study of the requirements of the primary forest-products industries of the United States for equipment, supplies, and manpower. This survey provided a detailed inventory of important items of equipment used during 1950 on commercial logging operations, and at sawmills and certain other wood-using plants; purchases and replacements of equipment and operating supplies; amounts and types of manpower employed in logging; and factors indicating the amounts of equipment, supplies, and manpower used to produce given quantities of timber products within specified periods. The survey showed, for example, that in the lumber industry 57 percent of the logs received in 1950 were obtained from company operations, 36 percent from independent commercial operators, and 7 percent from farmers and other miscellaneous sources. Mechanization is widespread throughout the logging industries, with 70 percent of the felling and bucking operations in the lumber industry and 60 percent in the pulpwood industry performed with power saws. In 1950 loggers owned about 27,000 crawler tractors and 111,000 trucks, and during the year purchased more than 5,000 tractors and 27,000 trucks. About 500,000 workers were employed on commercial logging operations.

In the field of marketing, a study of forest resources and markets in southern Illinois was completed and a report was published suggesting ways in which forests can contribute more to the income of the region through better marketing. Methods for obtaining data on stumpage and log prices were tested to determine the most efficient method for price surveys.

A study of forest-yield taxation was completed. Based on this study, a report, *Forest Yield Taxes*, was published, discussing the principles and applications of the yield tax, specific provisions of yield-tax laws, and the elements of a good yield-tax law.

Forest Products

The forest-products research conducted by the Forest Service is centered at the Forest Products Laboratory in Madison, Wis. The broad objective of this work is to make our forest crop go farther and serve mankind better. During the past year, as has been true in other times of national emergency, a large share of the Laboratory's effort has been aimed at providing the special research and technical services required by the defense agencies and industries in connection with the production, procurement, use, protection, modification, and conversion of forest products. A few examples of the Laboratory's activities follow:

Engineering design of fiber containers

Fundamental research at the Forest Products Laboratory has led to the development of formulas for the design of fiber boxes based on sound engineering principles. The variables in the design formulas include the strength of the fiberboard of which the box is made and the influence of scoring, printing, and similar factors on this strength. With these data and the atmospheric-moisture conditions under which the box is to serve, along with load and stacking requirements, and duration of storage, fiber boxes may now be scientifically designed. Heretofore, it was largely a cut-and-try proposition, often resulting in overstrength with consequent waste of material, or understrength with resulting loss and damage.

Instruction in improved small-sawmill practices

A "package" course, developed by the Forest Products Laboratory, has been made available to those interested in improving efficiency and reducing waste in the operation of small sawmills. This course consists of lecture material and lantern slides showing complete sawing procedure for whole logs. Field trials of the "package" have been enthusiastically received.

Warping of Parana pine

Large quantities of Parana pine are coming into the United States market from South America in the form of wide clear boards. The wood normally has uniform texture and machines smoothly. However, serious warping occurs in some boards. Frequent requests come from industrial users for information on proper methods of kiln drying and on the cause of the warping defect and means for its control. It was determined that the warping is caused by compression wood—abnormal wood formed on the lower side of leaning trees. Publications have been issued which facilitate the detection of compression wood in both rough and planed lumber and make it possible to sort for material free of compression wood.

Unbarked shortleaf pine in sulfate pulping

There are several reasons why it would be desirable to use unbarked wood in pulp production, provided the resulting paper met all use requirements. Costs of bark removal would be eliminated, longer wood storage periods would be possible before the pulpwood would dry to the moisture content at which decay occurs, and larger net yields of pulp might be obtained. Tests were made in which

shortleaf pine chips containing 8, 16, and 24 percent of bark were converted to kraft pulps of the sort suitable for brown wrapping paper, paper bags, and numerous other important uses. Up to 16 percent of bark (10 percent is believed to be a typical amount on pulpwood), the strength of the pulp was as good as that of pulps made from wood with the bark removed. Even with 24 percent of bark, bursting strength of the resulting paper was reduced only 8 percent. On the basis of the tests, an unpeeled cord of wood with 10 percent of bark would yield 5.4 percent more pulp than the same wood if it were peeled.

Instrument for measurement of veneer smoothness

In quality control work on veneers and in evaluating veneer from untried species, it is highly important to be able to make accurate measurements of smoothness. The Laboratory has developed an instrument that measures veneer roughness to the thousandth of an inch.

Color reactions a clue to lignin structure

The problem of determining the chemical make-up or structure of lignin is one which has baffled chemists for 100 years. Since millions of tons of lignin are wasted by chemical wood-processing industries, the answer to this problem is of considerable importance. So far, empirical work on the utilization of lignin has not shown the way to large-scale economical utilization. Fundamental studies on the structure of lignin now under way at the Laboratory have recently provided an initial clue to this difficult problem. Spectroscopic examination of color produced by the action of strong acids on wood has indicated that the color which develops is due in part to a material present in the lignin which can be identified.

Glycerin from wood sugar

A large part of the glycerin produced in this country is a byproduct of the soap-making and fat-splitting industries. The trend toward the use of synthetic detergents to replace soap is reducing the potential source of glycerin. This trend is of considerable concern to the Ordnance Department of the Army, since it affects the supply of one of the primary raw materials for nitration and double-base propellants. This concern has led the Ordnance Department to institute research at the Forest Products Laboratory on the production of glycerin and higher polyhydric alcohols from wood sugars.

Wooden vessel building program

The United States Navy has under way an extensive program for production of wooden vessels. The construction involves the use of laminated structural members. The Laboratory has been actively engaged, during the past year, in research and consultation related to a number of phases of that program. Difficulty in procuring sufficient quantities of white oak dictates consideration of the use of red oak, which must be treated with preservatives. Methods of gluing treated red oak are under study. The larger frames are of such size and form that shipment by common carrier is not feasible and, currently, most frames are being laminated by the shipyards. In order to broaden the base of supply, research is now under way to develop practical methods

of splicing frames made elsewhere and shipped to the yard in sections. The Laboratory, as a service to the Navy, is also conducting qualification tests on frames glued by various processors and, in addition, has acted as a consultant to those processors experiencing gluing difficulties.

Wood use at military installations

At the request of the Army Corps of Engineers, the Laboratory conducted a survey of the procurement, handling, and use of wood at various military installations. This survey disclosed that, in many instances, changes in procurement and handling practices could produce substantial savings to the Government. Among these are purchase of short lengths of lumber where they are suitable; increased use of lower grades; and increased use of thin lumber where specifications permit. To assist in effectuating such procedures, the Laboratory, at the request of the Corps of Engineers, prepared a Manual on Preparation of Requisitions for Lumber and Allied Products. The manual consists essentially of two parts: One gives a detailed explanation of how to prepare requisitions for lumber, plywood, poles, railroad ties, and other materials, so that procurement by the Corps of Engineers will be expedited; and the other, consisting chiefly of tabulated data, sets forth recommended minimum grades of materials for a wide range of military uses including boxes and crates, construction lumber, fencing, communication lines, wharves, and naval vessels. The objectives are to coordinate purchasing and assist requisition writers in selection of suitable grades in order to eliminate waste, reduce costs, and conserve material.

Investigation of hangar failure

By application of accumulated basic research, a Forest Products Laboratory specialist saved the Government nearly \$2,000,000 in connection with a large hangar in which one wood truss had failed. A cost of \$10,000 for replacement of a key wood truss instead of \$2,000,000 for complete replacement of its roof structure (as contemplated before the inspection) resulted from an examination and recommendation by the Forest Products Laboratory engineer. The recommendations on which this saving was based would have been impossible without the store of knowledge resulting from the fundamental research carried on over a period of years at the Laboratory.

A TIMBER RESOURCE REVIEW

The Forest Service this year began work on another periodic summary of the timber-resource situation in the United States. Known as the Timber Resource Review, this summary is the latest of a series of similar appraisals made at 8- to 10-year intervals to collect and interpret current facts of national scope as a basis for reorienting forest policy and making program recommendations. The last similar review of the forest situation was in 1945.

In current planning for this effort, the Forest Service is seeking the advice of State and private forestry agencies, the forest industries, and conservation, farm, and labor organizations. Their assistance is also being sought in determining the facts of the forest situation.

RIVER BASIN DEVELOPMENT AND FLOOD CONTROL

The Forest Service, through representation on the Department of Agriculture field committee, participated in the preparation of a supplemental report for the Missouri River Basin. This report (H. Doc. No. 530, 82d Cong., 2d sess.) emphasizes the need for remedial measures on watershed lands as a means of reducing flood damages.

In the Columbia Basin also, the Forest Service is contributing to the work of a departmental field committee which is preparing a comprehensive agricultural program for the basin, scheduled for completion during 1954.

In the Arkansas-White-Red River Basins and the New England-New York area, comprehensive surveys of water and land resources are being made by inter-agency committees on which the Department of Agriculture is represented. The Forest Service has primary responsibility for developing the forestry and related phases of the water- and land-resources programs and for coordinating and integrating them with other agricultural and nonagricultural programs for these regions.

Flood Control Projects and Surveys

The Forest Service is participating in flood-control projects authorized by Congress in the watersheds of the Coosa (Ga.), Little Tallahatchie (Miss.), Los Angeles (Calif.), Potomac (Va., W. Va., and Md.), Santa Ynez (Calif.), and Yazoo (Miss.) Rivers.

In the Coosa River watershed, improvements and facilities to protect the forests from fire have been installed. Organized protection was extended to several counties previously unprotected. This was accomplished through Federal-State cooperation, the costs being shared by the Federal Government and the State of Georgia. Installation of fire-protection facilities was also progressing in the Potomac River watershed, through Federal-State cooperation.

In the Little Tallahatchie-Yazoo watersheds more than 13½ million trees were planted on privately owned lands and nearly 2½ million on public lands in the project area. Project foresters assisted in the preparation of 959 farm plan agreements. One-third of the woodlands in the watersheds have now been covered by farm plans. The foresters aided 630 landowners on timber-management problems, and during the year 13,000 acres were added to the list of forest lands being managed according to recommended forestry practices. In cooperation with the State of Mississippi fire protection has been extended to all but four counties in the watersheds.

In the mountain area of the Santa Ynez River watershed installation of improvements and facilities for the control of fire is about two-thirds completed. The intensification of protection already has made it possible to suppress quickly many fires that could easily have become major conflagrations.

On one phase of the flood-prevention program for the Los Angeles River watershed the Forest Service is cooperating with the California State Division of Highways on stabilization of mountain-highway slopes. This work has been slowed because of the need for expenditures of State funds on other projects. Road slopes already treated,

however, successfully withstood some severe tests in the rainstorms of January 1952. Where formerly slips and landslides frequently occurred during such storms, the treated slopes held up under the impact of rain and runoff. Road-maintenance costs were thus reduced, and much less sediment was washed into the mountain channels above a flood-control reservoir. Recent rapid expansion of residential construction in the foothill areas of the watershed has aggravated the forest-fire protection problem on the chaparral-covered mountains nearby. Protection is provided in these areas through cooperation between the city and county of Los Angeles and the Forest Service.

During the past year the Department of Agriculture sent the following flood control survey reports to the Congress for its consideration. Each report has been published as a House document.

Watershed	State	H. Doc. No.
Brazos-----	Texas-----	396
Delaware-----	Delaware, New Jersey, Pennsylv- ania, New York, Maryland.	405
Grand (Neosho)-----	Arkansas, Oklahoma, Missouri, Kansas.	388
Pee Dee-----	South Carolina, North Caro- lina, Virginia.	395
Queen-----	Arizona-----	397
Sevier-----	Utah-----	406
Scioto-----	Ohio-----	409
Sny-----	Illinois-----	398
Green-----	Kentucky, Tennessee-----	261
Pecos-----	New Mexico, Texas-----	475

Flood-control surveys for 40 additional watersheds have been authorized by Congress, and the work on these surveys is under way. Reports on several of these should be completed and submitted to Congress during the current year. The Forest Service and the Soil Conservation Service cooperate in these surveys and in the preparation of the reports.

DEFENSE ACTIVITIES

As part of the defense production program the Forest Service has supplied the National Production Authority and other defense agencies with varied information on supplies and requirements for timber and wood products. Under this program applications from wood-using plants for Government loans or for accelerated tax amortization of new facilities have been referred to the Forest Service by NPA for appraisals of the adequacy of timber supplies available for the proposed new plant facilities. These investigations have furnished part of the basis for action by the Defense Production Administration in issuing certificates of necessity for new plant construction.

In the first year of the program the Forest Service prepared 250 resource reports on tax and loan applications and during the past year an additional 115 reports. The total of 365 resource appraisals prepared to date cover 280 expansions in the pulp and paper and rayon textile industries, 45 in the veneer and plywood industry, and 40 in

the lumber industry. These applications represent plant facilities valued at about \$1.6 billion, and possible additional drain on timber resources of approximately 13 million cords.

Favorable reports on timber resources were made for many applications located in areas where there is a current or prospective surplus of the kinds of timber required to support plant expansions. In other cases where applicants proposed to draw upon deficit areas where there is a prospective shortage of timber growth, reports were necessarily unfavorable. In still other cases favorable reports were predicated upon observance of specific conditions such as the utilization of hardwoods in lieu of scarce softwoods. In the latter cases, the defense agencies are incorporating such conditions in certificates of necessity.

Other defense activities of the Forest Service have included a variety of special investigations and reports in the field of forestry and forest products. Outstanding among these was the equipment-requirements study described earlier under "Forest Economics."

Closely related to the regular work of the Forest Service have been a number of additional projects conducted for the military and other defense agencies, including photogrammetry studies, research in photo interpretation for military purposes, research on special fire projects, and a wide variety of special investigations in the field of forest products.

FOREST SERVICE PERSONNEL

Recruitment

Although the enrollment in forestry schools declined during the scholastic year 1951-52 due to graduation of veterans who obtained their education under the provision of the GI bill of rights, the number applying for the junior forester civil-service examination resulted in an eligible list adequate to meet the recruitment needs of the Forest Service for the fiscal year 1952. The 1952 junior forester examination was held at an early date, enabling the Forest Service to receive a certification of eligibles in March 1952, and to make offers of employment to qualified senior students before their graduation in June.

As in other years since the end of World War II, the Forest Service had difficulties recruiting needed engineers and stenographers. Except for these two occupational categories the Forest Service has been able to maintain adequate personnel rosters.

Classification

The Forest Service classification review plan, placed in effect in 1949, and adopted by a majority of the regional offices and experiment stations, made it possible to meet expeditiously the recent legislative requirements for periodic review of positions and reporting of numbers and grades of positions.

Two classification training programs were organized and conducted by the Service's Classification Section. A training program specifically designed for administrative officers of six experiment stations was completed on February 1. A 6 weeks' training course for regional classification officers was completed on May 16.

The Forest Service was confronted with numerous problems in the employment of fire fighters and other short-term labor, especially in

the high-wage areas of the west coast, because of the wage freeze in January 1951. Negotiations to obtain Wage Stabilization Board approvals of wage rates in excess of the cost-of-living increases permissible under WSB regulations were necessary in some instances.

Training

At safety and training conferences in Ogden, Utah, Forest Service safety and training officers proposed policies to improve accident prevention and advance training of employees. The policy proposals were approved by the Chief. Better utilization of manpower was the keynote for employee training and development, with emphasis upon improvement of supervision at all levels.

Performance rating

Further improvement in application of the performance-rating plan, adopted in 1951, was made during the current year. For forest ranger and other positions for which job-load analyses, standards of performance, and related work plans exist, the rating plan is tied in directly to these. Examples of written performance requirements for other representative positions of various levels were distributed to the field to aid in putting all requirements into written "finished" form by the end of the year. Emphasis was placed on fuller mutual understanding between supervisor and subordinate as to duties and levels of performance; written notes, at rating time, on the needs for the employee's training and development; written notes similarly, as to existence and nature of weaknesses; and reporting, through channels, any outstanding performance or achievement.

Nineteen Forest Service employees received "outstanding" performance ratings for the year. In addition, 7 Forest Service employees as individuals and 1 Region as a unit received the Department of Agriculture's superior service awards, 34 individuals were granted meritorious promotions and certificates of merit, 41 cash awards were made, and 441 work improvement and employee suggestions were approved.

Retirement

During the fiscal year 91 Forest Service employees retired for age or by option. Their average age was 62.3 years; and they had an average of 30.2 years of service. An additional 49 employees were retired for disability.

STATEMENT OF RECEIPTS AND EXPENDITURES

National forests

Receipts from the national forests deposited to the forest reserve fund amounted to \$69,720,198. In addition there was collected \$1,448,975 from national-forest lands which were within the former indemnity limits of the grants to the Oregon and California Railroad Co., and \$233,338 from Tongass National Forest in Alaska, both of which were deposited in suspense pending proper disposition. Including these amounts, total receipts were \$71,402,511. Of the forest reserve fund receipts, \$63,722,986 was from timber; \$5,022,654 from grazing; and \$974,558 from special land uses, water power, etc. Of the amount credited initially to the forest reserve fund, \$131,588 is

returned to Arizona and New Mexico on account of State school lands within national forests; \$139,999 has been appropriated for acquisition of national-forest lands, and \$14,597 is derived from designated lands in the Superior National Forest for which special payment is made to the State in lieu of the usual 25 percent payment. Of the remaining \$69,434,014, 25 percent, or \$17,358,503, is paid to States for benefit of public schools and public roads of the counties in which national forests are situated; also, 10 percent of the same base amount and of the \$14,597, or \$6,944,861 in all, is appropriated to the Forest Service for roads and trails within national forests. From the remaining balance there is appropriated \$45,006 for payment to Minnesota on account of the designated area in the Superior National Forest and \$310,000 from grazing receipts of various national forests for range improvements on such forests.

Expenditures for national-forest operation, protection, and management were \$41,069,426. Additional expenditures from appropriations for forest roads and trails amounted to \$18,019,291, and for acquisition of national-forest land \$147,031.

Aid to States

Forest Service expenditures for cooperation with States and private agencies in fire control, planting, and assistance in forest practice were \$10,675,182.

Research and miscellaneous

Expenditures for research were \$5,419,643 and for flood control \$1,413,665.

A total of \$7,148,883 was also expended for fire control, slash disposal, improvement work, timber-stand improvement, and other work financed by outside agencies and from receipts authorized to be expended for specified purposes.

Services for other Government agencies from funds advanced or transferred by such agencies amounted to \$1,858,006, including \$110,925 for the Department of the Interior, \$1,034,752 for the Army, \$208,254 for the Navy, \$168,519 for the Department of Commerce, \$127,984 for the Production and Marketing Administration (Agriculture), \$78,407 for Defense Production, and \$129,165 for other agencies.

Total net expenditures were \$85,751,127. In addition, expenditures for which appropriations were reimbursed amounted to \$5,247,235 and expenditures from proceeds of sale of parts and equipment purchased in prior years \$383,584. Expenditures were accounted for by objective and functional classifications under 104 separate appropriation titles.

The Forest Service handled the naval stores conservation program, involving payment to farmers of \$425,649 from funds of the Production and Marketing Administration.

Excerpts From
Report of the Chief of the
Forest Service, 1953

Grazing on the National Forests



UNITED STATES DEPARTMENT OF AGRICULTURE

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Report of the Chief of the Forest Service, 1953

[Transmitted September 15, 1953]

MAJOR ACTIONS

The Forest Service engages in the following major activities: (1) The administration of 181 million acres of Federally owned land in 153 national forests; (2) cooperation with States and private owners in fire protection, tree planting, and forest management; and (3) forest, range, and watershed research through regional forest and range experiment stations and the forest products laboratory.

During the past year, the national forests have been the source of our most critical problems. This is to be expected and will continue to be so. It could hardly be otherwise, because the vast resources of the national forests affect the success or failure of countless business enterprises, and the economic and social well-being of countless thousands of American citizens and the communities in which they reside.

National-forest activities in the past year included supervising the cut of 5.16 billion board feet of timber and making some 22,000 new timber-sale contracts; grazing of some 1 million cattle and 3 million sheep under 23,500 permits; accommodating 33 million recreational visits, including 9 million visits from hunters and fishermen; administering 55,500 special-use permits for summer homes, resorts, telephone lines, water development, mineral leases, and other purposes; suppressing 12,000 forest fires, which burned 219,000 acres; planting 51,000 acres of forest land; reseeding 56,000 acres of range land; building 460 miles of roads; and maintaining 200,000 miles of existing roads and trails.

Following are some of the major policy actions of the past year.

1. Several administrative policy changes have been made or proposed with respect to grazing on the national forests. There has been progress toward legislation that would help livestock producers and, at the same time, safeguard the interests of all other national-forest users. These grazing policies and problems are discussed subsequently in more detail.

2. Consideration was given by the Congress to the possible need for revision of the mining laws as they affect the national forests. The Forest Service believes that discovery and utilization of the mineral resources underlying the national forests should be encouraged in every proper way; but it also believes some revision of present laws is needed to prevent unnecessary impairment of surface resources. Two congressional committees are currently studying the problem.

3. In timber management, a new policy has been developed for Federal sustained-yield units; timber-sale contract forms are undergoing important revisions, and methods of timber appraisal are under intensive study and review.

4. Positive and aggressive action is under way to minimize serious timber losses from insect epidemics in the Pacific Northwest and the Inland Empire.

5. The entire matter of Federal ownership of land has received much attention. New criteria have been adopted with respect to land exchanges and purchases. The Forest Service is intensively studying national-forest boundaries and purchase units, with a view to possible revisions.

6. An arrangement has been agreed upon between the Departments of Agriculture and the Interior which would settle the long-standing controversy over administration of certain national-forest timber lands in Oregon. In the meantime, disbursement to the State for the benefit of the concerned counties of 1.4 million dollars which has been held in escrow pending settlement of the controversy has been recommended to the Comptroller General. Upon final settlement, the counties will receive a substantial additional sum.

7. Organizationally, decision has been reached and progress made toward consolidation of 14 national forests and 2 regional forest and range experiment stations. Forest Service activities in Puerto Rico have been reorganized. The Insular forests, which for many years have been managed by the Forest Service, have been turned over to the Insular Government for administration, and an Insular Forester has been appointed. Forest Service participation in upstream flood-control surveys, flood-control action programs, and comprehensive river-basin studies has been reorganized and consolidated.

8. In research, a nationwide Forest Research Advisory Committee has been organized; coordination of Forest Service research with the Agricultural Research Administration has been improved; the research of the forest products laboratory and the regional forest experiment stations has been more closely integrated; and procedures have been developed which have greatly strengthened cooperative research with State agricultural experiment stations, forestry schools, and forest industry.

GRAZING ON THE NATIONAL FORESTS

Possibly no other phase of national-forest administration has been as difficult as grazing. A small but important segment of grazing permittees has been dissatisfied. Difficult problems of resource management have confronted our rangers and supervisors, and there appears to be considerable misunderstanding of departmental policy and facts of administration.

Periodically the administration of Federal grazing lands—both national forests and those under the administration of the Department of the Interior—has erupted into national issues which have required the attention of the Congress and Department heads. Because this situation prevails in 1953, I wish to report to you in some detail on national-forest grazing matters. I have not heretofore made a public statement on the grazing policies of the Forest Service nor the actions taken during the past year in an attempt to solve some of the major problems of range administration. It is my hope that this statement will clear up some misunderstandings and correct some false impressions.

As necessary background, I shall describe briefly the character and importance of national-forest range resources and the bare essentials of range administration and management. Emphasis will be on the major problems of range administration and the events of the past year pointing toward the solution of those problems.

RANGE RESOURCES

There are 104 national forests in the West comprising 138 million acres. Of this area, 44 percent, or about 61 million acres, is grazed by livestock. Most of the range is forested, much of it commercial timberland. All national-forest grazing lands, whether forested or open range, have important watershed values.

Types of vegetation differ widely because of extreme variations in elevation, climate, and soil. There are high-mountain subalpine grasslands and mountain meadows. Somewhat lower are the open-forest ranges of ponderosa pine and aspen. Still lower are the woodland ranges with a tree growth of pinyon pine, juniper, and oak. At still lower elevations are the open ranges of sagebrush-grass, the short-grass types, and the semidesert grasslands. The more dense timber stands of white pine, spruce, lodgepole pine, and Douglas-fir are relatively unimportant for grazing.

Western national forests have been grazed by domestic livestock ever since their establishment early in the 20th century. The same ranges were grazed for many years before the national forests were proclaimed.

Most western ranges became fully stocked in the late 1880's and early 1890's, a few in the 1870's—many years before the national forests were created. When placed in the national forests, many of the ranges were in deteriorated condition, not only as a result of past excessive grazing but also because of uncontrolled fires and other factors. Some of the range was plowed and cultivated to meet requirements of the homestead laws and later abandoned when found unsuited to farming. Demand for use of the range was great. To attempt to conserve forage was an invitation for others to come and get it. The memory of range wars between cattlemen and sheepmen was fresh. The destruction of range vegetation that already had occurred seriously reduced grazing capacity and watershed values.

Although progress had been made toward bringing grazing capacities and livestock numbers into balance on national-forest ranges, this progress was lost during World War I when livestock numbers in the West reached an all-time high.

Owing to the patriotic urge to produce as much meat and wool as possible, livestock increased on nearly all ranges. On national forests permitted cattle and horses increased 38 percent, from 1.6 million in 1914 to 2.2 million in 1918; and sheep and goats 12 percent, from 7.6 million to 8.5 million. Similar or even greater increases occurred on other public and private ranges.

Lower postwar prices for livestock, high costs of production, hard winters, and efforts to bring livestock numbers into balance with the forage supply brought about material reductions in both sheep and cattle on the national forests. Despite aggressive efforts to improve and manage the range, subsequent reductions in either livestock num-

bers or season of use have been necessary. The problem of bringing about a proper balance between livestock numbers and the forage supply constitutes a serious present-day problem in many parts of the West. This problem has been further accentuated in many areas by an increase in big game and accelerated demands for water and other national-forest resources.

About 1.1 million cattle and 3 million sheep graze western national forests, usually during the summer months under paid permit (table 1). These livestock are owned by some 20,000 permittees, who in fiscal year 1953 paid fees totaling 4.4 million dollars. In addition, over 52,000 head of livestock, primarily milk cows and work horses, were grazed without charge under regulations allowing free grazing to local settlers. Thus the grazing business on the national forests is a large one. It is one of the important uses of the national forests.

TABLE 1.—*Use of western national forests by domestic livestock and big-game grazing animals, stated years, 1908–52*

Calendar year	Domestic livestock			Big-game animal-unit-months ²
	Cattle and horses	Sheep and goats	Animal-unit-months ¹	
	<i>Thousand</i>	<i>Thousand</i>	<i>Thousand</i>	<i>Thousand</i>
1908-----	1,382	7,087	13,952	-----
1913-----	1,554	7,868	15,612	-----
1918-----	2,230	8,511	20,365	-----
1923-----	1,852	6,711	17,179	1,170
1928-----	1,436	6,416	12,672	1,590
1933-----	1,456	6,169	12,943	2,230
1938-----	1,301	5,310	11,062	2,850
1943-----	1,244	4,542	9,842	3,410
1945-----	1,245	3,893	9,136	3,620
1947-----	1,178	3,405	8,149	3,740
1949-----	1,140	3,096	7,645	3,970
1951-----	1,097	3,016	7,338	4,430
1952-----	1,105	3,005	7,332	4,430

¹ Estimated 1908 to 1923, since animal-unit-months not reported prior to 1926.

² Big-game population estimates not available until 1921.

The number of national-forest grazing permittees is about 31½ percent of the total number of livestock growers in the West. Of the total beef cattle population in the Western States about 11 percent graze on national forests a part of the year. Of the total stock sheep, approximately 22 percent graze on national forests. The forage furnished by the national forests is about 7 percent of the total feed requirements of western livestock.

Although the numbers involved are relatively small, and the forage furnished is not great compared with total needs, national-forest grazing is very important to the stockmen permittees. This is especially so because the high-mountain national-forest summer ranges form an essential link in the chain of grazing use with the lower elevation spring, fall, and winter ranges and improved ranch property, which

provide feed during the remainder of the year. These lower ranges are usually Federal grazing districts, State lands, or privately owned. Thus the seasonal national-forest summer ranges hold a key position in the yearlong operations of many producers.

The agricultural economy of the West, which is based largely on irrigation and livestock production, is inseparably linked to national-forest ranges. This is true, not only because of the grazing use of these ranges, but also because they are primary water-yielding lands. In general, western agriculture depends on a pattern of land relationships wherein comparatively small areas of water-consuming lands are directly dependent on extensive tracts of water-yielding forest and range lands. The national forests of the West embrace the headwaters which furnish most of the flow of major western rivers and streams used for irrigation, waterpower, and domestic purposes. The future of the West depends on how well these water-yielding lands are managed.

Grazing on national forests of the East and South is of growing importance to the local agricultural economy, but the national forests of the East are too small in number and size for the grazing use ever to be of major importance in livestock production. About one-fourth of the 22 million acres of eastern national forests is grazed by domestic livestock. In 1952 about 2,800 permittees grazed 36,000 cattle, 1,400 sheep, and 800 hogs, mostly in the South and Southeast. There are problems of conflicts between grazing and timber production in these areas which are being studied but which have not yet been generally resolved.

The policy problems of the Forest Service with respect to grazing come almost entirely from the West; and this statement is directed exclusively to western conditions and problems.

RANGE ADMINISTRATION AND MANAGEMENT

By the Act of 1897 the Congress specified that the purposes of the national forests were to secure favorable conditions of waterflow and to furnish a continuous supply of timber. It also instructed the Secretary to regulate their "occupancy and use." Under this broad authority, production of water and timber are the two major purposes of the national forests, but grazing by livestock has always been recognized as an important use. Thus in 1905, at the time the Forest Service was created, the Secretary of Agriculture, James Wilson, wrote the Chief of the Forest Service:

You will see to it that the water, wood, and forage of the reserves are conserved and wisely used for the benefit of the home-builder first of all; upon whom depends the best permanent use of lands and resources alike. The continued prosperity of the agricultural, lumbering, mining and live-stock interests is directly dependent upon a permanent and accessible supply of water, wood, and forage, as well as upon the present and future use of these resources under businesslike regulations, enforced with promptness, effectiveness, and common sense.

The grazing regulations of the Department, the history of the administration of the national forests, Supreme Court decisions, and the various Appropriations Acts all provide a broad legislative and administrative base for recognition of grazing by livestock as a proper use of the national forests. This base was further strengthened by

the Granger-Thye Act of 1950. However, such grazing use must be integrated and coordinated with the multiple-use policy of management which recognizes water and timber production as paramount uses with equitable consideration for the interests of stockmen, recreationists, hunters and fishermen, and the general public.

The Department has traditionally fostered two policies in its administration of the grazing resources of the national forests:

(1) Proper stocking and improvement of the range resource to achieve desirable watershed conditions and sustained high-level production of forage. Over many years the Department has attempted to bring livestock numbers into balance with available forage. This is being done by building up forage production through reseeding, other range-improvement measures, and by better management. Where this is not sufficient, necessary adjustments to grazing capacity have been made in either numbers of permitted livestock or season of use.

(2) Equitable distribution of the grazing privileges to favor the medium and small rancher dependent on national-forest range; but with due consideration to the larger permittees.

Grazing Allotments and Permits

National-forest range lands are divided by the Forest Service into "allotments" or use units, which are simply areas of land specifically designated for grazing use by specified numbers of livestock. The size of allotments is based primarily on the number of livestock to be grazed but is affected also by accessibility, topography, availability of forage, stock water, and related factors. Nearly 10,000 allotments have been designated on western national forests. Most of these are grazed by only one kind of livestock, either cattle or sheep, although some are grazed by both. Allotments may be designated to be grazed by the livestock of a single permittee or in common with animals owned by other people in the community.

The privilege of grazing a certain number of livestock for a definite length of time is allocated by the Forest Service through issuance of grazing permits to qualified applicants. In order to qualify, a rancher has had to meet certain requirements prescribed under departmental regulations. First of all, he has to own ranch property. He also has to own his livestock. He has to need national-forest range to round out his yearlong feed supplies.

The demand for grazing on the national forests has always exceeded the supply. Therefore it has been necessary to establish rules to determine which stockmen would be given permits. When the national forests were established, the prior users were given preference in the issuance of permits. After that local settlers and ranchers living in and near the forests were next in line of priority. After several years of continuous use the permittees established what have become known as "preferences." Thus the general pattern of grazing use has been fairly well crystallized for a long period of time and has resulted in establishing a group of preferred applicants for use of national-forest range. In order to provide a reasonable degree of flexibility in business transactions between permittees, it has been customary for the Government to transfer preferences from a per-

mittee to a purchaser of his ranch property or permitted livestock. This has been the principal way in which new permittees have obtained grazing privileges on the national forests since the original allocation of permits to prior users.

However, where surplus range is available, the practice has been to allocate it first to existing small permittees and secondly to qualified new applicants. There has also been provision for reducing the number of livestock in larger permits to take care of the needs of small permittees and needy new applicants. This is known as "distribution," and has been one of the controversial issues for many years.

In order to avoid concentration of an undue share of the range in a few permits, so-called "upper limits" have been established above which existing permits ordinarily are not allowed to increase.

A rancher who wishes to obtain a grazing permit applies to the forest supervisor or ranger having supervision over the national forest where the rancher wishes to graze animals. If the applicant meets the necessary requirements and if range is available, he will be given a permit for a definite number and kind of livestock for a definite number of months upon payment of specified fees. Most permits run for 10 years. There also is provision for issuance of temporary permits.

The average grazing period is a little over 5 months each year for cattle and somewhat less than 3 months for sheep. Most of the permits are seasonal (mostly summer); but some, particularly in the Southwest, are yearlong.

Range Management

Forage is a renewable resource and responds to management, whether good or bad. On national forests, forage is recognized as a resource available for the production of livestock and big game. In management, the plan of action is to restore forage production on ranges which may be deteriorating and to maintain it on a sustained-yield basis both on those ranges and others already in satisfactory condition.

Four major interdependent phases are involved in the Forest Service range-management program. If properly harmonized with the findings of research and practical experience, the trend will be toward soil stabilization, sustained yield of the most valuable forage species, stabilized livestock operations, and maximum yields of meat and animal products. The four phases are:

- (1) Inventory, survey, or allotment analysis. This is an assembly of facts and information on soil, forage production, condition and current trend of soil and forage, developments and improvements needed, relation of range use to other uses, and best season of use. The survey may indicate the need for additional study of any one of these items, but its main purpose is to provide information for management of the allotment.

- (2) The management plan and its application. The management plan for an allotment is a product of the inventory and seasonal-use study, worked into a practical, usable system of grazing use. It is a guide to proper management, and its successful application

depends upon close cooperation between the stockman and forest officer. The plan sets up season of use, grazing capacity, and how livestock should be distributed. It may include a plan for alternate or rotational use of subunits within the allotment, a listing of existing and needed range improvements, and additional details.

(3) Field inspection and utilization determination. This also is a cooperative on-the-ground followup by the stockman and forest officer on the application of the plan and careful consideration of possible need for its revision as to ways and means of obtaining better distribution of livestock; rotation systems to insure greater value from forage; need for maintenance of improvements or additional installations; what can be done to correct sore spots on the range either through management or reseeding; and checks for degree of utilization.

(4) Condition and trend studies. These are needed as a followup to determine what is happening and will probably happen in the way of improvement or deterioration if the plan of management, inclusive of present rates of stocking and seasons of use, is continued. Forest Service range technicians have for years relied upon time-proven earmarks of improvement or deterioration which have been developed by research or experience. In order to check more closely and to provide for a more methodical record of what was happening on the range, especially in doubtful cases, the Forest Service in 1948 developed what is known as the "three-step method" for determining trend in condition. This is now being widely applied on western national-forest ranges and consists of (1) periodic collection of data at permanent benchmarks on representative parts of the ranges; (2) classification of condition and estimation of trend on the range unit; and (3) establishment of permanent photo-points.

The Forest Service depends on Department of Agriculture research for improved aids and guides to range management, revegetation, and noxious-weed control. Research findings are always subjected to pilot testing prior to wide-scale application to determine their practicability. Much research information developed by the Forest Service is being used by other land-administering agencies as well as by stockmen on private ranges.

MAJOR PROBLEMS OF RANGE ADMINISTRATION

The major grazing problems over the years between the Forest Service and grazing permittees may be grouped into six items: (1) Numbers of livestock and seasons of use; (2) distribution of grazing privileges; (3) transfer adjustments; (4) advisory boards and appeal procedures; (5) grazing fees; and (6) competition between big game and livestock.

Numbers of Livestock and Seasons of Use

The question of how many livestock should be allowed to graze the range always has been a major issue between permittees and the Forest Service. Reductions in numbers of livestock and seasons of use have always been and still are strongly resisted. Many ranges were being overgrazed when the national forests were established.

They were further damaged during the first World War, when the Government encouraged livestock production and the number permitted on the national forests reached an all-time high. Since then, and despite reseeding, other range improvements, and better management, substantial reductions have been necessary in order to conserve the range resource. On many national-forest ranges, numbers are now in balance with feed supplies. On others, grazing capacity and livestock use are not yet in balance.

The Forest Service does not rely on reductions in numbers of livestock as the only means of bringing grazing capacity and numbers of livestock into balance. Despite some feeling to the contrary, the Forest Service has aggressively pushed a range reseeding and improvement program. The Government has invested about \$3.5 million in reseeding national-forest ranges and another \$16.9 million in fence building, development of water places, stock driveways, and other range improvements. These are direct expenditures only and do not include costs of overhead or supervision. A complete range-development program for western national forests would cost approximately \$100 million. The history of appropriation requests shows that more funds have been requested repeatedly for this work than have been made available.

In addition, grazing permittees are encouraged to spend their own funds in developing national-forest range lands. During the past 10 years, some \$2.3 million of private funds has been spent in construction of range improvements and in revegetation. Additional private contributions worth about \$650,000 annually have been made in the form of material and labor (table 2).

TABLE 2.—*Construction of range improvements on western national forests, 1943-52*

Fiscal year	Kind of improvement				Cost all improvements		
	Range fences	Stock driveways	Water	Revegetation	Federal expenditures	Private (cooperative) expenditures	Total expenditures
	<i>Miles</i>	<i>Miles</i>	<i>Number</i>	<i>Acres</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
1943-----	230	15	350	8,099	11,424	185,938	197,362
1944-----	257	36	364	11,329	67,803	206,138	273,941
1945-----	308	14	336	7,291	54,203	214,139	268,342
1946-----	242	39	189	30,126	100,593	234,047	334,640
1947-----	449	40	348	33,837	447,242	192,179	639,421
1948-----	326	18	317	51,388	504,295	263,226	767,521
1949-----	442	26	322	67,144	797,417	367,145	1,164,562
1950-----	584	48	556	62,457	775,991	477,600	1,253,591
1951-----	319	16	240	55,033	836,532	111,699	948,231
1952-----	245	6	157	55,453	847,403	50,188	897,591
10-year total---	3,400	258	3,179	382,153	4,442,903	1,230,299	5,673,202

¹ In addition to the private cooperative expenditures shown, permittees on western national forests in recent years have made contributions in labor, materials, etc., toward both construction and maintenance of range improvements, averaging about \$650,000 annually.

Where grazing capacities of the national forests are thus increased by expenditure of private funds, the permittees making the investment are given reasonable assurance that the benefits from such expenditure will accrue to them. A revised policy recently adopted is designed to give added assurance.

Distribution of Grazing Privileges

Range forage on the national forests is a public resource. The Department has a responsibility for the development of equitable rules and regulations and for their fair application in deciding who will get the use of this public resource. Because national forests are public property, the Government must retain the right of decision as to who is privileged to use that property.

Even though the Government's right of "distribution" is seldom exercised, it is a basic matter of principle that the Government retain this right. Some stockmen have felt that, because of the demand for national-forest grazing privileges, the Government should be prohibited from awarding future privileges to any but present grazing permittees, or persons of their selection. This has been a major issue—not of practice, but of principle.

In the past, distribution rights have been exercised occasionally by the Government to award grazing privileges to new settlers and to applicants who have had insufficient range to support a small ranch. As the West has become more settled and stabilized, there has been less and less need for distribution. This is recognized in a recently announced proposal to modify policies covering distribution.

During the 13-year period 1927–39 detailed records of distribution adjustments were kept. In each of these years, with one exception, only a fraction of 1 percent of grazing permits and permitted livestock were affected by distribution (table 3). Since 1939 there have been practically no such adjustments.

TABLE 3.—*Grazing permits and livestock affected by reductions for distribution on western national forests, 1927–39*

Calendar year	Cattle and horses				Sheep and goats			
	Permits affected		Livestock affected		Permits affected		Livestock affected	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1927-----	5	0.02	80	0.01				
1928-----	20	.10	1,050	.07	1	0.02	1,388	0.02
1929-----	11	.06	874	.06	4	.06	816	.01
1930-----	137	.69	3,835	.28	22	.34	19,034	.28
1931-----	59	.30	1,008	.07	6	.09	5,930	.09
1932-----	89	.44	985	.07	4	.06	2,555	.04
1933-----	38	.19	881	.06	4	.07	2,910	.05
1934-----	36	.18	1,279	.09	15	.25	9,180	.15
1935-----	1,086	5.31	15,500	1.15	522	8.69	100,423	1.75
1936-----	45	.22	715	.05	11	.19	5,063	.09
1937-----	15	.08	551	.04	9	.16	3,404	.06
1938-----	17	.09	472	.04	5	.09	2,675	.05
1939-----	1	.01	22	.002				

Detailed records not kept on distribution reductions before 1927 or after 1939. Practically no distribution reductions have been made since 1939.

Associated with the question of distribution of the grazing privilege is that of stability of tenure once the privilege is granted. Statements have been made implying insecurity of tenure and consequent economic risk to the permittee.

The rarity of distribution adjustments is one evidence of stability. The substantially higher premium paid for ranches or permitted livestock with national-forest grazing privileges is evidence of both (1) the low risk of distribution and (2) the high degree of stability of a national-forest permit.

Of all grazing permits on western national forests, about 40 percent have been held by the same family for more than 30 years; over half for more than 20 years; nearly three-fourths for more than 10 years; and about one-fourth for 10 years or less (table 4).

TABLE 4.—*Permits existing on western national forests as of 1952 which had been in same family for varying periods of years*

Permit period	Cattle permits		Sheep permits		Total permits	
	Number	Percent	Number	Percent	Number	Percent
All permits.....	15,334	100	2,444	100	17,778	100
Period in same family:						
10 years or less.....	4,397	28.7	675	27.6	5,072	28.5
More than 10 years.....	10,937	71.3	1,769	72.4	12,706	71.5
More than 20 years.....	8,395	54.7	1,251	51.2	9,646	54.3
More than 30 years.....	6,139	40.0	862	35.3	7,001	39.4

¹ Does not include packer permits and small special-use pasture permits.

Furthermore, most permits in the 10-year-or-less category are so classified because of recent sales of ranch property. Actually, most such permits have been in effect for the same ranch or permitted livestock for considerably more than 10 years.

Transfer Adjustments

Transfer adjustments mean reductions in numbers of permitted livestock or length of grazing season at the time of transfer of grazing preference from one party to another, usually at the time of sale of the base ranch property or permitted livestock. Transfer adjustments may be made for either conservation of the range or for further distribution of the grazing privilege.

Some grazing permittees and others have felt that the Forest Service automatically reduces the number of permitted livestock whenever a transfer of preference occurs. The facts are that in the past 5 years, 1948-52, about 6 percent of the 19,000-odd paid permits annually were involved in transfer cases. Reductions were made in 44 percent of these transfer cases or an average of 467 each year (table 5). Of the transfer reductions, only 3 were for distribution and only 28 cattle were involved. All the rest were for range protection or conservation. In terms of livestock less than 1 percent of permitted numbers were affected during the 5-year period.

Some of these reductions at time of transfer have been strongly protested and are the source of the impression that reductions are auto-

matic at time of transfer of preference. A revised policy, tentatively approved and now under consideration by the livestock industry, would help to prevent further misunderstandings on this point by providing that reductions would be made as and when needed without relation to transfer of grazing privileges.

TABLE 5.—*Transfer cases and reductions in numbers of livestock incident to transfer occurring on western national forests, 1948-52*

Year	Paid permits	Transfer cases	Ratio of transfer cases to paid permits	Transfer cases in which reductions were made	Ratio of transfer cases involving reductions to all transfer cases	Reductions in numbers of livestock incident to transfer cases	
						Cattle and horses	Sheep and goats
	<i>Number</i>	<i>Number</i>	<i>Percent</i>	<i>Number</i>	<i>Percent</i>	<i>Number</i>	<i>Number</i>
1948-----	20, 177	1, 196	6	661	55	6, 851	33, 892
1949-----	19, 634	1, 029	5	434	42	5, 951	22, 009
1950-----	18, 481	1, 092	6	461	42	5, 878	26, 532
1951-----	18, 390	1, 184	6	460	39	5, 946	21, 642
1952-----	19, 550	822	4	321	39	5, 041	4, 516
Total-----	96, 232	5, 323	6	2, 337	44	29, 667	108, 591
5-year average-----	19, 246	1, 065	6	467	44	5, 933	21, 718

Reductions at time of transfer are sometimes strongly protested because it may be to the substantial financial advantage of the permit holder not to have any reduction made in the preference at the time he sells his base property or permitted livestock. The purchaser, and prospective transferee of the grazing preference, customarily pays an extra premium to the permit holder in the expectation of having the latter's national-forest preference transferred to him. Since this premium may amount to several hundred dollars per head for cattle, the seller naturally opposes any reduction in the preference.

Advisory Boards and Appeal Procedures

The Forest Service has always encouraged the formation of local grazing associations and advisory boards through which permittees could express collectively their views and recommendations regarding management policies. Over the years more than 800 such boards and associations have been organized. These boards are actively functioning today. The Granger-Thye Act of 1950 gave statutory recognition to grazing advisory boards, established the procedures by which the boards shall be constituted and elected, and specified their functions.

When a grazing permittee is dissatisfied regarding an administrative decision affecting him, he can appeal to the immediate superior of the officer by whom the decision was rendered. Thus he can appeal from the decision of the forest ranger to the forest supervisor, thence to the regional forester, to the Chief of the Forest Service, and to the Secretary of Agriculture.

In lieu of this procedure the permittee may, if he desires, request to have his case heard by the appropriate grazing advisory board. If he is not satisfied with the board's recommendations to the forest

supervisor, or the latter's action on the board's recommendation, he may then appeal through regular channels to higher levels.

There is also a National Forest Advisory Board of Appeals made up of qualified Department employees outside the Forest Service to advise the Secretary on appeals from decisions of the Chief of the Forest Service. Upon request of the appellant, and prior to decision by the Secretary, the appeal is referred to this board, which considers the case on its merits and then makes its recommendations.

This administrative appeal process appears to be functioning satisfactorily. Every appeal is given the most careful consideration. Informal hearings and field examinations are common.

In the 33 years, 1920-52, there were 1,195 appeals from ranger to forest supervisor, of which 271 were wholly or partly reversed (table 6). Appeals to higher levels of administration were progressively fewer. Reversals decreased from about 22 to 8 percent. There were 973 appeals from forest supervisor to regional forester of which 250 were reversed; 303 from regional forester to the Chief with 37 of these reversed; and 83 from Chief to the Secretary of Agriculture with 7 reversals.

Because most appeals deal with numbers of livestock or seasons of use, it is significant that during the same 33-year period when there were about 1,200 appeals to forest supervisors, some 84,000 administrative decisions on these matters were made without appeal.

Under the present appeals process, decisions of the Secretary of Agriculture are final, unless the appellant wishes to appeal to the courts on the basis of violation of law or arbitrary or capricious action. This recourse has always been open to him.

TABLE 6.—*Formal grazing appeals on western national forests, 1920-52*

Calendar year	Number of decisions not appealed ¹	Ranger to Supervisor		Supervisor to Regional Forester		Regional Forester to Chief, Forest Service		Chief, Forest Service to Secretary of Agriculture	
		Number of appeals	Number appeals reversed in whole or part	Number of appeals	Number appeals reversed in whole or part	Number of appeals	Number appeals reversed in whole or part	Number of appeals	Number appeals reversed in whole or part
1920-----	2, 384	16	6	30	16	10	2	0	0
1921-25----	14, 361	98	18	78	34	50	6	17	2
1926-30----	11, 517	112	17	120	26	40	2	14	0
1931-35----	13, 324	197	31	164	48	44	3	8	0
1936-40----	12, 063	196	59	164	26	32	3	7	1
1941-45----	12, 766	198	53	130	21	43	5	4	0
1946-50----	13, 046	293	60	220	49	67	8	31	3
1951-----	2, 285	51	16	26	2	13	6	1	1
1952-----	2, 304	34	11	41	28	4	2	1	0
Total----	84, 050	1, 195	271	973	250	303	37	83	7

¹ Confined to decisions made by ranger or supervisor relating to numbers of livestock and seasons of use.

Grazing Fees

The privilege of grazing on the national forests is allocated by the Forest Service to qualified applicants. Forage is not sold to the high-

est bidder, as is timber. In that fact alone lies part of the reason for permittee resistance with respect to necessary reductions in permitted livestock and grazing fees. The historical reason for allocation rather than sale to the highest bidder stems from the early land policy of the Congress to encourage the settler and small rancher, as part of western development.

National-forest grazing fees are derived from a base fee which was put into effect in 1931. This base fee was determined after lengthy study by stockmen and Department officials, comparing the value of national-forest range with values of comparable leased private, State, and other Federal range. By administrative decision and after conferences with representatives of the livestock industry, the base fee was set considerably lower than amounts paid for comparable private range. Grazing fees for each year are determined by adjusting the base fee according to annual fluctuations in the market price of beef cattle and lambs, as reported by the Bureau of Agricultural Economics.

For 1953 the average monthly fee per head is 54 cents for cattle and 11¾ cents for sheep (table 7). This is substantially lower than the rate paid for comparable private range, but substantially higher than that for Bureau of Land Management range and most State-leased land.

TABLE 7.—*Grazing fees and receipts from grazing on national forests, 1933-53*

Calendar year	Average monthly fee per head		Total grazing receipts (fiscal year)
	Cattle	Sheep	
	<i>Cents</i>	<i>Cents</i>	<i>Dollars</i>
1933.....	9. 05	2. 05	1, 498, 209
1934.....	7. 51	2. 385	1, 358, 688
1935.....	8. 04	2. 71	1, 151, 153
1936.....	13. 05	3. 36	1, 441, 493
1937.....	12. 55	3. 66	1, 580, 345
1938.....	14. 98	4. 24	1, 696, 457
1939.....	13. 4	3. 3	1, 573, 912
1940.....	14. 89	3. 68	1, 463, 127
1941.....	15. 97	3. 85	1, 429, 091
1942.....	18. 9	4. 6	1, 595, 126
1943.....	23. 0	5. 5	1, 973, 233
1944.....	26. 0	6. 25	2, 458, 946
1945.....	24. 8	6. 03	2, 158, 626
1946.....	27. 0	6. 25	2, 059, 676
1947.....	31. 0	7. 5	2, 293, 773
1948.....	40. 0	10. 0	2, 898, 637
1949.....	49. 0	11. 0	3, 275, 964
1950.....	42. 0	10. 75	3, 385, 004
1951.....	51. 0	12. 25	4, 165, 573
1952.....	64. 0	15. 25	5, 022, 654
1953.....	54. 0	11. 75	4, 415, 862

Total grazing receipts reached an all-time high of over \$5,000,000 in 1952, but were still less than 10 percent of revenues from timber sales.

It is frequently pointed out by stockmen who are not permittees, as well as by members of Congress, that the lowness of national-forest grazing fees constitutes a substantial Federal subsidy to the permittees. This is one reason why ranches which have grazing privileges on the national forests command a premium when sold. If national-forest fees were equal to going commercial rates, the premiums purchasers would be willing to pay would disappear or be greatly reduced, and revenues to the Government would substantially increase.

Different principles are now followed in the establishment of grazing fees on the national forests and on the Federal grazing districts administered by the Department of the Interior. On the national forests, fees are geared to both the value of the forage and annual market fluctuations in livestock prices. On the Federal grazing districts fees are geared primarily to the cost of range administration and are not adjusted annually. On lands administered by the Bureau of Indian Affairs, the usual practice is to award grazing privileges on a competitive bid basis.

Grazing fees have been in controversy in the past and doubtless will be again. But at present they are not a major issue.

Competition Between Big Game and Livestock

Big-game grazing use has about doubled on the national forests in the past 20 years (table 1). Feeding habits of these animals differ from domestic livestock, and they tend to frequent rougher country and more timbered ranges which are less favored by domestic livestock. Nevertheless, there is competition in some areas between big-game grazing animals and domestic livestock for national-forest forage. This is true, especially where both use the same range and where numbers are out of balance with the forage supply.

When big-game populations were at low ebb during the early 1920's, positive steps were taken by the States to build up big-game numbers. These were so successful that in many places overpopulation of game animals resulted. But public opinion was slow to accept this, and State authorities have frequently been delayed in getting the necessary authority to apply control measures. There is close cooperation between the States and the Forest Service, and progress is being made in reducing problem herds.

Big game is an important national-forest resource, and sportsmen are an important group of national-forest users. Competition between the big game and domestic livestock cannot be entirely eliminated. Where such conflicting interests are involved, the best solution lies in application of the long-standing multiple-use management principle of the national forests. This principle recognizes that each use is proper, and strives to maintain as desirable a balance as possible between the two.

SUMMARY OF EVENTS OF PAST YEAR

Changes in Administrative Policy

1. *Increased grazing capacity, resulting from range improvement work financed by the permittee.*—The purpose of this policy change is to give permittees greater assurance that they will receive the benefit from range improvements on national forests which they themselves finance. The new policy was reviewed in its formative stages by the livestock industry and other interested groups, and was formally adopted on April 14, 1953.

Under the new policy, increased grazing capacity resulting from reseeding or other range-improvement work at the permittee's expense will be available for use by the permittee or permittees making the investment, provided the improvements (1) are approved in advance under either a special-use permit or cooperative agreement; (2) do not conflict with other uses of the national forests; (3) are beneficial to the range; and (4) continue to be effective.

The policy also provides that use of the increased grazing capacity may consist of (1) increased forage for existing permitted numbers of animals where the present supply is inadequate, or (2) increase in permitted animals or animal-months after range conservation needs are fully met. Where an increase in permitted numbers is allowed, such increase will be recognized as being of the same status and subject to the same policies that apply to other grazing preferences.

2. *Distribution of grazing privileges.*—Department policies have long provided for so-called "distribution" adjustments in large permits, in order to provide increases in small permits or to admit new and needy small applicants.

Since 1939 practically no adjustments for distribution have been made. Probably few, if any, such adjustments will be made in the foreseeable future. For these reasons, a change in Departmental regulations is under consideration to delete specific provision for distribution adjustments. This would require corresponding adjustments in the Forest Service Grazing Manual.

However, the broad, general legal authority to make such adjustments would still exist both in Departmental regulations and in law. The legal authority is based on the Act of June 4, 1897, which permits grazing on the national forests and authorizes the refusal of applications for renewal of grazing permits in whole or in part if in the public interest to do so. This law also authorizes the prescribing of conditions and requirements under which permits will be issued or terminated.

Under the proposed policy, existing permittees will feel that there is less likelihood of distribution adjustments, and a corresponding increase in the stability of national-forest grazing permits. In accordance with past practice and the provisions of the Granger-Thye Act in 1950, this proposed policy change has been submitted to the livestock industry, grazing advisory boards, and other interested groups for their review and suggestions.

3. *Transfer adjustments.*—Reductions in numbers of permitted livestock at the time a permit is being transferred from one permittee to a new permittee have been a source of much friction. When such

reductions are made, it is usually for purposes of range conservation or protection, and but rarely for distribution. It is sometimes felt that the Forest Service automatically reduces numbers of permitted livestock when a permit is transferred, regardless of the need.

Department policies on this matter have changed from time to time. Prior to 1949, a maximum reduction of 20 percent could be made for either range conservation or distribution when a preference was transferred in connection with purchase of either ranch property or livestock. But where the transfer involved purchase of both ranch property and livestock, the maximum permissible reduction was 10 percent. In 1949 the percentage provisions were eliminated with respect to range conservation adjustments, but a maximum of 20 percent still applied to distribution adjustments. The 1949 policy, under which the Forest Service has been operating, provides that no grazing preference is to be transferred for numbers greater than the estimated grazing capacity of the range.

A new policy has been tentatively approved, which would provide that necessary reductions in numbers of permitted livestock in order to conserve the range would be made as and when planned without relation to any transfer of the grazing preference. As in the case of the revised distribution policy, this change has been submitted to the livestock industry, grazing advisory boards, and other groups for their review and suggestions.

Under the policy, scheduled reductions which happen to coincide with transfers would be made as scheduled. Protection reductions would not be planned to coincide with transfer of permits, but neither would needed reductions at such time be prohibited. The Forest Service would continue its past policy of giving both prospective seller and purchaser of base property or permitted livestock the fullest possible information concerning estimated grazing capacity, condition of the range, and probable status of the preference after transfer. This policy will remove any question of automatic reductions at time of transfer.

Legislative Events

The first session of the 83d Congress gave much attention to grazing on the national forests. Six bills, three in the Senate and three in the House, would affect national-forest grazing in important ways. These are: (1) Identical bills, S. 1491, by Senator Butler for himself and Senator Barrett, and H. R. 4023, by Congressman D'Ewart; (2) companion bills, S. 1509, by Senator Aiken, and H. R. 4268, by Congressman Hope; and (3) identical bills, S. 2548, by Senator Aiken, and H. R. 6787, by Congressman Hope.

The Butler-Barrett-D'Ewart bills were prepared by a Stockmen's Grazing Committee after much consideration, and hearings were held on them by both the House and Senate Interior and Insular Affairs Committees. The Department did not testify and took no position on them. Although the congressional committees did not report the bills, the press gave national publicity to them and to the hearings. This served to focus nationwide attention on national-forest grazing matters.

The first two bills by Senator Aiken and Mr. Hope—S. 1509 and H. R. 4268—would have enacted some Departmental policies into law,

and would have provided for multiple-use advisory councils. The bills received little attention in the Congress; hearings were not held; and the Department took no position on them.

Both before and after the hearings on the Butler-Barrett-D'Ewart bills, representatives of stockmen and other groups were in consultation with both the Forest Service and the Secretary's office. Subsequent to the hearings on these bills, Senators Aiken and Barrett and Congressman Hope and D'Ewart, under Senator Aiken's leadership, endeavored to develop legislation which would be mutually acceptable to the various interested groups and in the public interest. The Department participated in these endeavors as technical adviser.

On July 31, 1953, the President submitted to the Congress a message relative to "A Program Designed To Conserve and Improve the Nation's Natural Resources." The message made specific reference to the grazing resources of the national forests, and stated: "The Federal Government has a responsibility to manage wisely those public lands and forests under its jurisdiction necessary in the interest of the public as a whole. . . . Public lands should be made available for their best use under conditions that promote stability for communities and individuals and encourage full development of the resources involved." On the following day, Senator Aiken and Mr. Hope introduced S. 2548 and H. R. 6787, identical bills, which would implement the President's message and which were introduced at the request of the President.

These bills deal with construction of range improvements by permittees, transfer of grazing privileges, base property standards, an economic study to help develop a method for determining grazing fees, boards of appeal with respect to grazing uses, formal hearings, and appeals to the courts. The bills also spell out certain exceptions to their provisions, and recognize the importance of all resources and uses of the national forests. The Department has recommended their enactment.

It is evident from the preceding statement and summary that much attention has been devoted to grazing on the national forests during the past year, not only in the Forest Service but also in the Secretary's Office and the Congress. This is because of the importance of grazing on the national forests and the tension surrounding some of the problems of range administration. Progress toward better understanding and partial resolution of some of the most difficult problems has been made. There has been no arbitrary action by the Forest Service. Interests of all groups have been considered, and the problems have been discussed with all groups of users. There is better understanding of Departmental policies and procedures by grazing permittees, other user groups, and members of Congress.

There will always be some conflict of interests between various users, between water production and grazing, between sportsmen and stockmen, between big game and domestic livestock, and even to some extent between timber and grazing. But the Forest Service will make every effort to keep such conflicts to a minimum through good administration and management. There is every reason to believe that the great majority of grazing permittees on the national forests are reasonably well satisfied with Forest Service administration.

THE YEAR'S WORK

NATIONAL-FOREST ADMINISTRATION

The year's work in various phases of national-forest administration is reviewed in the following pages. Range management on the national forests is discussed in the preceding section, so is omitted here.

Receipts Exceed Expenditures

Again in fiscal year 1953, the cash receipts from national-forest operations reached a new all-time high. The national forests took in receipts amounting to \$76,463,746 for the year. This total did not include some \$1,500,000 collected by the Department of the Interior for oil and gas leases on national-forest lands. The 1953 receipts were well above the previous record of \$71,402,511 for fiscal year 1952.

Last year's expenditures from regular appropriations for the national forests, including both the current operating and capital expenditures, amounted to \$64,540,364. The receipts thus exceeded expenditures by nearly \$12,000,000.

In addition to the increase in cash receipts, there was an estimated increase last year of more than \$70,000,000 in the value of capital assets of the national forests. This estimate is based on increases in stumpage values and annual timber growth.

The greatest public values of the national forests, of course, are those that cannot be readily expressed in monetary terms. The value of such benefits as reduction of floods, assurance of dependable water supplies, contributions to community stability, and outdoor recreation for millions of people, is indeed beyond reckoning. Yet the substantial cash income of the national forests more than covers the cost of obtaining these benefits.

Financial returns to the States

Congress has provided that an amount equal to 25 percent of the gross receipts from the national forests be paid each year by the United States Treasury to the States for distribution to counties containing national-forest lands. These payments, which totaled \$18,649,794 for fiscal year 1953, are for the county school and road funds.

Some counties where national forests are doing a big timber-sale business are getting very large annual payments. For counties which have only a small amount of national-forest land or where the values on much of the land are noncommercial, the payments are small. Where deforested lands have been acquired for national-forest purposes, the yearly payments will be low during the period of forest restoration, but may be expected to increase in later years.

In addition to these direct cash payments to the States, Congress has provided that 10 percent of the national-forest receipts be made available each year for expenditures on forest roads and trails in the States of origin. Direct appropriations also are made for forest highway and road construction and maintenance. The forest highways built with these appropriations are important links in the States' main highway system.

Besides the expenditures for road construction and maintenance, there are many other contributions-in-kind to the States and local communities. These include maintenance of organized fire-control forces, reforestation and other development work that greatly benefits the States, and the costs of which otherwise would have been borne by the States and local governments alone.

In the aggregate, these payments-in-kind plus the 25-percent payments greatly exceed the total of taxes that the State and local governments might derive from the national forests if they were subject to taxation. On the average, the value of the contributions-in-kind alone more than equals the estimated total tax potential of the national-forest lands.

Watershed Management

Because the national forests occupy many of the water-yielding areas at high elevations, a substantial part of the Nation's water supply originates within their boundaries. The yield of water from western national forests is particularly significant. In the 11 Western States the national forests yield about 53 percent of the total runoff although they occupy only 21 percent of the area. In addition to this measurable streamflow, large amounts of water sink into the ground in the national forests to help recharge underground water basins which furnish a substantial portion of the total water supply.

The national forests are a major source of water for some 1,800 cities and towns. Hundreds of other communities and thousands of residents of rural areas also receive all or part of their water supply from these public forest watersheds, often located many miles away in another State. Much of the irrigation agriculture in the Western States depends on water from national-forest watersheds. These forests are the source of water for more than 600 hydroelectric power developments, and for thousands of industrial plants. It is therefore a prime purpose in protecting and managing the national forests to assure a regulated waterflow of good quality for the communities, farms, and industries dependent on that water supply.

Soil classification is being undertaken in California and the Pacific Northwest as a basis for attaining better watershed and other management practices. Washington State College is cooperating with the Forest Service on soil classification work now well along on the Gifford Pinchot National Forest. In the same region a special study of drainage and erosion control on roads and trails has been under way during the past 2 years. In California a vegetative-soil survey in the Mendocino National Forest is being conducted with the cooperation of the University of California, the Bureau of Plant Industry, Soils, and Agricultural Engineering, and the Soil Conservation Service. Over 400,000 acres have been covered. This survey is furnishing information of great value for correlating land-management activities for better watershed management.

The Forest Service is continuing its efforts to improve the usefulness of the water resource through studies of upstream water requirements and to arrange for suitable water releases from large upstream reservoirs to preserve fish life and enhance recreational values. A recent development in this field is a cooperative investigation in connection with power projects on the Feather River in California. Co-

operating with the Forest Service are the Pacific Gas and Electric Company, the California State Department of Fish and Game, and the United States Fish and Wildlife Service.

Another cooperative project in California including Federal, State, and private groups and individuals resulted in a joint report entitled "A Coordinated Land and Water Conservation Program on the Pit (Pilot) Soil Conservation District," completed in March 1953. Participants included the Pit Soil Conservation District, the Soil Conservation Service, Bureau of Land Management, California State Division of Water Resources, State Department of Fish and Game, the Shasta Forests Company, and the Forest Service.

A striking watershed management demonstration can be seen in the Jefferson National Forest in Virginia. Here the water supply of the town of Narrows has been transformed from a state of high turbidity following storms to one of very satisfactory clear flow. This change was brought about by checking the erosion on logging roads left by an operator of timber reserved for cutting by the owner when the land was sold to the Federal Government. As a result of the effectiveness of the treatment the town has cooperated with the Forest Service in planting 10,000 trees and has plans for planting an additional 10,000 in the watershed.

Power developments

Action on several hundred power cases during the year indicates continued peak activity in that field. The power transmission lines on national-forest land operating under Federal Power Commission license or Forest Service permit now total more than 1,000 miles. This includes cooperative lines of the Rural Electrification Administration.

Water storage

Fifteen new dams were approved for construction on national-forest land during the past year, bringing the total number of artificial reservoirs to over 1,700.

The development of water resources by reservoir construction within national forests sometimes has profound effects on the management and utilization of other national-forest resources. The submerging of main avenues of access to the upstream watersheds may disrupt sustained-yield timber working circles and fire-control systems. In some cases whole valleys of productive timberland may be inundated, fishing streams and recreational and other facilities eliminated. Two such reservoir projects, Libby Reservoir, planned by the Corps of Engineers in Montana, and Oroville Reservoir, by the State of California, are being given cooperative study to reduce their potential adverse effects on national-forest resources. Each agency is contributing funds to the Forest Service for conducting investigations and developing plans to aid in coordinating the interests of the Forest Service with those of the dam-building agency.

Timber Management

Timber harvested from the national forests in fiscal year 1953 amounted to 5,160 million board-feet, the highest annual cut in the history of the Forest Service. It was an increase of 742 million feet

over the 1952 cut. Receipts from sale of timber in 1953 were \$70,-616,025, again setting a new record.

The total cut included harvest of mature timber and cuttings made to improve growing conditions in crowded stands. Substantial quantities of Christmas trees, naval stores, and other forest products not expressible in board-feet, also were harvested.

A total of 22,020 timber sales were made during the year. Most of these were small sales, involving small timber operators. Of the total, 19,891 were for less than \$1,000 each; 1,087 between \$1,000 and \$5,000; and 1,042 over \$5,000. There were 2,309 sales of miscellaneous forest products.

Access roads needed to attain full sustained yield

The national forests of the United States contain some 73 million acres of commercial forest land. On the basis of current growing stocks, existing markets, and utilization standards, the sustained-yield capacity of these national-forest timberlands is estimated to be at least 6.9 billion board-feet. This estimated capacity will increase as the basic growing stocks are further built up and as utilization practices further improve.

Although the 1953 timber cut was the largest volume ever harvested from the national forests in any single year, it still was 1,740 million feet below present sustained-yield capacity. The full yield capacity of the national forests cannot be harvested mainly because many of the timber stands cannot yet be reached. Lack of access roads is principally a problem of the national forests of the West. These western national forests contain almost one-third of the total volume of saw-timber remaining in the United States. Here lies much of the potential for increase in national-forest timber yield.

Three types of timber access roads are needed: (1) Mainline roads, providing primary access to major drainages or large timbered areas; (2) lateral roads, that feed into the primary system and serve smaller drainages and blocks of timber; and (3) logging spurs, the low-standard roads which penetrate to all parts of areas being logged. Mainline roads and most laterals should be permanent roads that will be available for hauling the timber crop as harvested. Lateral roads usually receive intermittent use because they give access to smaller timber volumes. Logging spurs are constructed by the timber purchasers and are usually temporary roads serving small areas.

Mainline and lateral roads may be constructed either by the Government or, as a timber-sale requirement, by the timber purchaser. Whether the public or a timber purchaser builds the road the cost is borne by the United States. If the timber purchaser builds it, the anticipated cost is deducted from the price he can be expected to pay for the timber. If the Government provides the road, a correspondingly higher price for stumpage can be obtained.

At present very few national-forest working circles are wholly accessible for timber harvesting. For many of the partially developed working circles some new construction and reconstruction will be needed to maintain even the current rate of timber harvesting. Additional new construction will be needed to increase the cut to full sustained-yield capacity. The cost of additional access roads within the next few years will be more than offset by the income from increased timber sales.

First pulp mill in Alaska

The Forest Service in July 1951, accepted a bid from the Ketchikan Pulp Company to purchase 1½ billion cubic feet of timber in the Ketchikan pulp-timber unit of the Tongass National Forest in Alaska. In accordance with the terms of the timber-sale contract, this firm is now constructing a pulp plant of around 350 tons daily capacity at Ward Cove near Ketchikan. This, the first major pulp plant in Alaska, is scheduled to go into full operation on July 1, 1954.

The opening of this operation will mark the fruition of 30 years of effort by the Forest Service to bring about the development of a pulp and paper industry in Alaska. Year-round industrial activity is badly needed to expand and develop southeastern Alaska. Pulp and paper manufacture offers one of the best prospects for building up this section of the Territory.

Insect control

An epidemic of southern pine bark beetles appeared on and near the Homochitto National Forest in Mississippi late in the spring of 1952. Previously an ice storm had damaged many trees in the area, providing favorable host material for a rapid insect buildup. Drought conditions over a period of a year or more also had weakened many trees so that they were easy prey for the beetles. The Forest Service, the State Forester for Mississippi, and private land owners in the area immediately started a cooperative control project. The Bureau of Entomology and Plant Quarantine provided overall technical advice. Control work consisted of logging several million board-feet of infested trees, supplemented by chemical treatment of trees and parts of trees which could not be logged. Fast, concerted effort by all cooperators has brought the epidemic under control and saved a resource worth many millions of dollars.

An outbreak of Engelmann spruce beetles started in the summer of 1952 in western Montana and northern Idaho. The epidemic was the result of violent windstorms of 1949 that knocked down a tremendous number of trees, resulting in ideal conditions for a buildup of the beetles. Already many million board-feet of standing spruce timber of fine quality are infested and will die. Over 12 billion board-feet of spruce timber are ultimately threatened. As a result of prompt Federal, State, and private cooperation a plan of control has been developed, and operations started in the spring of 1953. A substantial program of access-road construction and logging of infested trees is planned. This will be supplemented by chemical treatment. Seventy-eight percent of the spruce timber is on national-forest lands.

The Engelmann spruce bark beetle control project carried on in Colorado for the past 3 years has resulted in successful control of this epidemic.

Reforestation

During fiscal year 1953, 51,249 acres of national-forest land were planted or seeded to trees. Successful plantings now total 1,496,915 acres. A substantial amount (28,058 acres) of the past year's seeding and planting was done on areas recently cut over, with funds deposited by timber purchasers under terms of the Knutson-Vandenberg Act of 1930. This Act authorizes the Forest Service to require, in addition to the charges made for timber sold, deposits of funds to be used for

reforestation and stand improvement of timber-sale areas to keep such lands growing high-quality timber. On other national-forest areas, 23,191 acres were planted and seeded with funds appropriated by Congress. Some 4 million acres of national-forest land need reforestation to put them to work producing timber for an expanding population.

Costly planting is avoided whenever measures can be taken to facilitate the establishment of natural regeneration on burned and cutover areas. Where seed-bearing trees still stand, timely control of seed-eating rodents and scarification of the soil surface often help a new crop of seedling trees to become established. During the year 21,464 acres received such treatment.

Timber stand improvement

Funds collected in connection with timber sales, under authority of the Knutson-Vandenberg Act, make possible some timber stand improvement work each year looking to the establishment of natural tree growth and protecting it through the critical period of early growth. This work also helps to obtain stocking of trees of desirable species, form, and quality. Timber stand improvement in promising young growth not associated with timber-sale cuttings is done with funds directly appropriated by Congress. During the past year the following timber stand improvement work was done with "K-V" funds and appropriated funds:

	<i>Acres</i>
Plantation release.....	19, 438
Natural stand release, weeding, and thinning.....	264, 623
Pruning.....	103, 224
Animal control (hogs, etc.).....	245, 943
Rodent control.....	39, 308
Disease control.....	56, 954
Other.....	43, 078

Recreation

Public use of the national forests for recreation again reached an all-time high in 1952, with 33 million visits reported. This was a 10-percent increase over the previous year. It was 83 percent greater than in 1941, the year of highest prewar use.

Forty-two percent of the visitors used the camp and picnic-ground facilities. Fishing, hunting, skiing, hiking, and riding were other popular recreational activities. The national forests provide the most widely used public properties in the United States for those seeking these outdoor, forest-type recreation activities.

The policy of making a moderate charge for use of the camping, picnicking, and swimming facilities was continued at some 45 of the larger, better improved camp and picnic areas. Most of these were operated by concessioners, who could meet the costs of operation and current maintenance out of the money collected. (Funds collected at charge camps operated directly by the Forest Service go to the U. S. Treasury and are not available for maintenance and cleanup work.)

Facilities still overtaxed

As the use of national-forest recreation areas steadily increases, it is becoming more and more difficult, with the funds and manpower now available, to maintain the camp and picnic grounds in safe and

sanitary condition. Overcrowding and the steady deterioration of sanitary and fire prevention facilities present an acute problem. Several bills aimed at relieving this situation were introduced in the 83d Congress.

Winter sports

Within the past two decades, skiing has become a major recreational activity in the United States. The national forests, particularly in the West, afford some of the country's best and most heavily used ski terrain. To meet the growing demand, the Forest Service has developed some 200 winter sports areas. On some national forests skiing now ranks first as a recreation pursuit.

Four new ski lifts and warming-shelter buildings were completed under special-use permit during the year. They represent an investment of more than a million dollars of private capital. All ski lifts, tows, and shelter buildings on the national forests are operated on a concession basis under Forest Service permit.

The study of avalanche-hazard forecasting and control under way at Alta, Utah, Berthoud Pass, Colo., and Stevens Pass, Wash., is producing some worthwhile results. Degree of avalanche hazard can now be determined by evaluating 10 different snow and climatic factors which contribute to the occurrence of avalanches. An "Avalanche Handbook," the first of its kind in the United States, was published for field personnel and cooperators in 1953.

Wilderness areas

Conservation organizations are taking an increasingly active interest in the perpetuation and management of the 79 wilderness areas that have been set aside within the national forests. A meeting attended by members of the Natural Resources Council from many parts of the country was held in Washington early in the year to consider wilderness area policy and management.

One new area, the Linville Gorge Wild Area, within the Pisgah National Forest of North Carolina, has been added to the wilderness-area system. It comprises 7,610 acres of southern forest types, including extensive areas of rhododendron and laurel, bisected by the rugged Linville Gorge. It is the first wild area established in the East.

The Executive Order establishing an airspace reservation over the canoe wilderness area of the Superior National Forest in Minnesota has been upheld by the Federal District Court and the Circuit Court of Appeals. Frequent violations occurred at the outset, but these have ceased after some prosecutions in Federal court.

Wildlife

Wildlife is one of the major recreational resources of the national forests. Nearly 9 million visits were made to the forests for hunting and fishing last year. One reason the national forests are so popular with sportsmen is that these forests offer a public hunting and fishing ground of 180 million acres where the sportsmen are not restricted by "No Trespassing" signs. Moreover, the quality of the sport found on most areas is high.

Production of wildlife on the national forests is advanced under multiple-use management. Protection of the forests from uncon-

trolled fire, and sustained production of timber, forage, and water all contribute to the maintenance of a desirable environment for wildlife. Furthermore, wildlife needs are given specific consideration in all phases of resource management.

The Forest Service wildlife-management program involves two major approaches. These are (1) the protection and improvement of the habitat, and (2) the maintenance of close cooperative relationships with the State fish and game departments.

Favorable environment or habitat is a basic requirement for sustained production of fish and game animals. This is because every animal must have a place to live, a place where its requirements for water, food, and cover can be met. Very often the Forest Service can adjust uses of the forest to protect or even improve wildlife food and cover conditions.

The Forest Service seeks close cooperative relations with the State fish and game departments. State game laws apply on the national forests. Thus the State agencies are handling the protection and utilization of the wildlife resource. Since management of the land (the wildlife habitat) is a responsibility of the Forest Service, cooperation is mutually advantageous.

During the past year, the wildlife section of the Forest Service Manual of instructions for administrative officers was completely revised, in order to bring up-to-date and reemphasize major policies and objectives in this field. Prior to final approval, representatives of the States and other cooperators were asked to review the revised draft. Many valuable suggestions were received.

Cooperative agreements

In Indiana an agreement covering both national-forest and State-forest lands established objectives for a long-term program of intensive habitat improvement. A special area agreement covered part of the national forests in Texas and was designed to implement habitat improvement through a State Pittman-Robertson project. The existing cooperative agreement in West Virginia was revised in line with new State legislation providing for special State-collected fees for hunting and fishing on national-forest lands.

Cooperative habitat management on Virginia's national forests stressed development of wildlife openings by means of timber sales. In California a cooperative habitat-improvement project was the State-financed construction of flow-control dams on headwater streams to provide continuous water supplies for fish during the summer and fall periods. Other work in California included clearing and seeding of brush fields to provide openings for wildlife, and development of watering devices for quail.

In the national forests in Wisconsin, cutting of cedar in winter deer yards was restricted to the winter period so that tops and other slash would be available to supplement scanty food supplies. Location of sales was also designed to give maximum benefit to deer. In the national forests in Wisconsin and northern Michigan extensive areas of openings were left unplanted to provide sharptail grouse range. Special management plans were prepared for these areas. In North Carolina progress was made in developing timber-cutting methods which would provide sprouts for deer food and still retain an adequate growing stock of timber.

Overpopulation problem

Utah held its first statewide either-sex deer hunt in 1952, to help meet the problem of overpopulation. Wyoming and Colorado both set two-deer bag limits on several heavily populated areas where an increased kill was desirable. Michigan and Pennsylvania enacted new legislation permitting more liberal harvesting of problem deerherds. Indiana and Virginia anticipated critical problems from growing deerherds and held either-sex hunts. In Indiana this was the first deer hunt in more than 50 years.

Special Land Uses and Mining

Special uses

The use of national-forest land for a variety of purposes is authorized by special-use permit. Over 50,000 such permits, embracing some 2 million acres, were in force last year. They covered some 110 different types of uses, such as summer homes, resorts, telephone lines, television stations, pastures, military camps and maneuver grounds, etc.

With the advent of television and microwave transmission systems, national-forest lands have assumed a new importance for relay and transmitting stations. Since high locations for visible range are essential, many national-forest peaks have become very valuable for transmission and relay sites, particularly in California and other parts of the West. The authority of the Department of Agriculture to grant easements for telephone, telegraph, and transmission lines has now been broadened by action of Congress to include sites for radio and television purposes and to extend the width of rights-of-way for power and telephone lines. In order to protect the future interests of the United States the Forest Service reserves certain rights of joint use at sites suitable for television and relay stations.

Mineral leases

Lands in those national forests established under the Weeks Law may be leased for the utilization of minerals, under such provisions as may be necessary to safeguard other national-forest values in the public interest. In national forests reserved from the public domain, the Mineral Leasing Act of 1920 provides for the leasing of lands for development of certain specified minerals—coal, oil, gas, oil shale, sodium, sulfur (in Louisiana and New Mexico), phosphate, and potassium.

Mineral leasing, particularly for gas and oil, continues to be an important activity on the national forests. It requires careful supervision, however, to prevent damage to surface resources. The leases are issued by the Bureau of Land Management in the Department of the Interior. The Forest Service reviews each application and recommends to the Bureau of Land Management the stipulations which should be incorporated in the lease to protect surface values.

On western national forests an estimated 4 million acres of national-forest land is under lease for gas and oil development. There has been considerable interest during the past year in manganese deposits in the Appalachian area, and in the search for nickel, cobalt, copper, and related minerals in the Superior National Forest of Minnesota.

Mining claims

On the national forests reserved from the public domain, the General Mining Laws give any person the right to locate, enter, and patent national-forest land upon discovery of mineral values (except for the eight minerals covered by the Mineral Leasing Act).

Minerals are important resources of the national forests. Prospecting for and utilization of mineral resources is desirable forest use, in line with the policy for multiple-purpose administration of national-forest lands. Many minerals are critically needed, and the Forest Service wishes to encourage their discovery and development.

The large number of mining claims, however, has caused a serious problem in the western national forests. Of some 36,600 claims covering over 918,000 acres that have been patented within the national forests, it has been estimated that only about 15 percent have ever been commercially mined. In 1952 there were an estimated 84,000 unpatented claims, covering 2,163,000 acres of national-forest land and supporting timber worth more than \$100,000,000. But only an estimated 2 percent of these claims were being commercially mined.

Mining claims frequently interfere with the orderly harvesting of timber. Much of the problem is brought about not by bona fide miners but by those who may have no intention of doing any real mining and may be attempting to obtain title to valuable public timberland or summer home sites by using provisions of the mining laws. There is no limit to the number of claims a person may file on, and in rare instances a single claimant or group of claimants has located on thousands of acres of high-value public timber, watershed, and recreation land.

Several bills looking to the modification of the mining laws are pending in the 83d Congress. These include proposals to protect the surface values of lands within the national forests, and to remove deposits of sand, stone, gravel, pumice, and cinders from location under the General Mining Laws, and provide for their disposal on a permit basis.

Hearings were held during the year by the House Committees on Agriculture and on Interior and Insular Affairs. Later, a joint subcommittee of the two committees was appointed to study the mining claim problem with a view to reaching an agreement on corrective legislation.

At the request of the Secretary of Agriculture, the National Forest Advisory Council investigated the mining-claim problem, and reported to the Secretary describing the situation and recommending remedial legislation.

The Forest Service hopes that a solution to the mining-claims problem can be found which will encourage the development of national-forest mineral resources without unnecessary impairment of surface values.

Fire Control

In 1953, up to July 31, the Forest Service fought 4,360 fires in the national forests. This was well below the figure for the corresponding 7-month period of 1952, when 5,469 fires were reported. The acreage lost in 1953, however, was much greater—160,250 acres burned

in the first 7 months of 1953, compared with 52,894 acres in the corresponding period of 1952.

A big share of this acreage loss occurred in California. Early in the summer, dry weather and strong winds caused several fires to roar away to large size before control could be established. Some 67,000 acres were swept by fire in the national forests of California during the 7-month period.

In one of these fires, 15 fire fighters lost their lives. They were members of a crew fighting the Rattlesnake Fire on the Mendocino National Forest in northern California. The tragedy occurred on July 9, when a sudden change in the wind caused the fire to jump a road and overtake the men before they could get out of its path. The fire was of incendiary origin. It was brought under control on July 11, after burning over 1,100 acres. Regional investigators were in the field the day after the disaster, and 4 days later the Chief of the Forest Service appointed a Board of Review.

In August, dry lightning storms caused large numbers of fires in the national forests of the northern Rocky Mountain and Pacific Coast States. California had 197 lightning-caused fires on August 13 and 137 on August 14. Forest Service regional headquarters for Montana and North Idaho reported more than 1,100 lightning fires in the first 20 days of August. Smokejumpers made more than 800 parachute jumps, and half a million pounds of air freight was transported to fires burning in the inaccessible areas of this region.

The 1952 fire year

The Forest Service in 1952 experienced one of its longest and most hazardous fire seasons. Drought conditions during the fall months all over the country were the worst faced in 25 to 30 years. In the Western States the active fire season, which usually ends in September, extended an additional 60 days well into November. No major conflagrations developed in the national forests of the West, however, despite the critical fire conditions. Most of the larger fires on national-forest lands during the fall months occurred in the Southeast, where an unusually dry summer and fall was experienced. In this region more than 600 fires started in October and November, when few fires normally occur.

During 1952 the Forest Service controlled 11,965 fires in the national forests. Of these, 4,944 were caused by lightning. Man-caused fires totaled 7,021, many of which occurred during the late fall fire season.

During the year 219,590 acres of forest and watershed lands within the Forest Service protective boundaries were burned over, compared with 395,625 acres in 1951. This reduction in burned acreage was accomplished despite an increase of 1,580 in the number of fires.

Mechanizing fire suppression

Of some 2,500 miles of fireline built in 1952 to control the 11,965 forest fires in national forests, 820 miles were built with machinery. Most of the machine-built fireline was in the Southern Region, where the topography and timber types are especially suited to use of machinery in controlling forest fires. Specialized plow equipment for use in different fuel and soil types has been developed and successfully used there.

Small portable, self-propelled equipment for fireline construction is being developed and field tested in the western regions. Twenty-five flail-type, and three spiral fireline trenchers are now in use on an experimental basis. The flail-type trencher weighs 260 pounds and is designed for parachute delivery from an airplane for use on back-country fires by smokejumpers. A lightweight portable power brush and sapling cutter and a lightweight brush and grass mower have been demonstrated along with the trenchers.

Trucks with pumper-tanker apparatus were used on 2,189 fires last season. On 998 of these fires, the equipment was used for fast initial attack. During the past 3 years special slip-on fire-pumper-tanker units for 1½- to 1-ton pickups and 1½-ton trucks have been developed. These were adopted as standard for the Forest Service during 1952. About 200 of the new smaller sized units are now in field use with various protection agencies.

Smokejumpers and aircraft use

Smokejumper crews are stationed during the fire season at Missoula, Mont.; McCall, Idaho; Chelan, Wash.; and Cave Junction, Oreg. The smokejumpers attacked 267 fires in 1952. On these fires, 836 individual jumps were made and 1,375 man-days were worked. An estimated \$1,300,000 of the fire-suppression costs were saved by use of the smokejumpers on these back-country fires.

Airplanes were used in 1952 to transport more than 8,000 men and approximately 525,000 pounds of fire equipment and supplies, about 250,000 pounds of which were dropped to men fighting fire in inaccessible country. About 11,000 hours of flying were necessary. Use of helicopters dropped from 548 hours in 1951 to 76 hours in 1952, because of a lack of suitable commercially operated helicopters available to the Forest Service.

Improvements and Facilities

Roads and trails

A total of \$24,336,000 was available for construction and maintenance of national-forest roads and trails in fiscal year 1953. Of this total, \$11,000,000 was available from appropriations authorized by section 23 of the Federal Aid Highway Act of 1948, and \$6,963,892 from "10 percent funds" (10 percent of national-forest receipts for fiscal year 1952) allocated for roads and trails as provided by the act of March 4, 1913. The balance was from unobligated funds made available in fiscal year 1952.

These funds were programmed for:

Maintenance of 80,341 miles of road, and 119,433 miles of trails.

Replacement of 693 unsafe bridges.

Construction of 41 new bridges.

Reconstruction and surfacing of 264 miles of roads.

Construction of 463 miles of road (including 326 miles for timber access).

Included in the construction figure was 27 miles of road on the Siuslaw and Umpqua National Forests in Oregon to facilitate the sale of dead and threatened timber in stands infested by the Douglas-fir bark beetle. Purchasers of the timber will build the additional branch roads needed for salvaging this timber.

In fiscal year 1953, 887 miles of permanent timber-access roads were built and 352 miles of existing roads were improved by purchasers of national-forest timber.

Congress provided a supplemental appropriation of \$5,000,000 for timber-access roads in Idaho and Montana where an infestation of bark beetles threatens to destroy extensive stands of Engelmann spruce. Access roads will aid the salvage of trees that are already dead or dying, as well as facilitate control measures. The infestation might have been avoided if an adequate system of timber-access roads had existed to make possible the prompt sale and removal of trees uprooted and weakened by severe windstorms in 1949 and 1950. These wind-damaged trees subsequently became a breeding ground for the bark beetles.

National-forest transportation system

The existing transportation system currently includes 20,269 miles of forest highways, 117,229 miles of forest development roads, 120,821 miles of trail, 86 landing fields for rigid-wing craft and 5 heliports suitable for rotary-wing craft. States and counties maintain 48,467 of the 137,498 miles of forest highways and roads. Purchasers of national-forest timber and other road users maintain 9,517 miles of national-forest development roads.

Forty-two percent of the roads in the national-forest transportation system are inadequate for the class of traffic that uses them. States and counties have assumed the maintenance obligation for a considerable mileage of the better national-forest roads in recent years. But the Forest Service maintains a large mileage of low-standard roads used heavily by forest recreation seekers and other public traffic. Upkeep of these roads drains a major portion of the total road funds available to the Service. A few of these roads are already used in excess of their safe capacity while many fail to provide the all-weather service sought by local residents.

Mapping

During the fiscal year 1953, the Forest Service completed control surveys and topographic maps for 922 square miles of national forests and adjoining lands in Arizona, California, and Idaho.

Planimetric maps were completed for 21,913 square miles of national forests and adjoining lands in Montana, Colorado, Arizona, New Mexico, Idaho, California, Oregon, Washington, and Pennsylvania.

Contracts for aerial photography for both national-forest mapping and resource-inventory purposes were awarded for a total of 6,266 square miles. Bids are pending for an additional 11,300 square miles.

National Forest Properties

On June 30, 1953, the net area of the 153 national forests and other lands administered by the Forest Service was 181,273,765 acres. This compares with 181,145,764 acres as of the same date in 1952. During the year, therefore, no major changes in national-forest areas occurred.

Lands may be given national-forest status or be removed from that status by executive or legislative action and by purchase, exchange, and donation. During the year, 196 exchange transactions involving national-forest lands or timber were approved pursuant to the several

exchange laws. In these transactions, the landowners offered to the Government 210,312 acres of lands within or adjoining national forests in exchange for 256,106 acres of national-forest land or land utilization project lands and about 81 million board-feet of national-forest timber. Thus there was a net relinquishment of about 46,000 acres in exchange transactions during the year.

A total of 7,969 acres were approved for purchase during the year, with an obligation of \$99,288. This small acreage is principally in the national forests established under the Weeks Law in the eastern United States, including the wilderness canoe area of the Superior National Forest in Minnesota. Eight donations, involving 3,245 acres of land were accepted during the year.

A number of changes involving administrative status of Federal lands were made. Transfers out of the national forests included 6,043 acres from the Olympic National Forest to the Olympic National Park in the State of Washington, and 2,745 acres from the Coronado National Forest to the Coronado National Monument in Arizona. Transfers of Federal land to national-forest status included 91,800 acres of rural rehabilitation lands in New Mexico, which has been administered by the Forest Service since 1947; about 5,100 acres of military reservation lands in Montana; and about 33,000 acres of public-domain lands in Montana.

During the past year, increasing attention has been directed by groups and individuals to questions of forest land ownership, and particularly Federal ownership. The Forest Service also is giving much study to this matter. A reexamination of national-forest boundaries and purchase units is under way.

COOPERATION IN STATE AND PRIVATE FORESTRY

The development of the national forests and advancement of State and private forestry work have gone forward together. Each complements the other.

The Weeks Law of 1911 provided both for the establishment of national forests in the headwaters of navigable streams and for Federal participation with the States in cooperative protection and management on non-Federal lands. The Clarke-McNary Act of 1924 and subsequent legislation broadened and strengthened the authorizations for these programs.

In many ways the national forests have been instrumental in encouraging the initiation and development of protection and management on State and privately owned forest lands. The cooperative programs for the protection of forests from fire and destructive pests, production and distribution of planting stock, and technical assistance to forest owners and the processors of forest products are designed to further encourage and facilitate good forestry practice on non-Federal lands.

The Secretary of Agriculture has been authorized to cooperate with the States in these programs, and he has delegated these authorities to the Forest Service. In addition, the Forest Service participates actively in developing the forestry practices to be included in the Agricultural Conservation Program, and for a number of years has been assigned directly the administration of the naval stores conserva-

tion phase of that program. The Forest Service also supplies subject-matter information for the farm forestry extension work conducted by the land-grant colleges and State extension services in cooperation with the Department of Agriculture's Extension Service.

Forest Management Assistance to Woodland Owners

Thirty-eight State forestry departments are cooperating with the Forest Service in providing on-the-ground technical assistance to owners of private forests and to small sawmill operators and other processors of primary forest products. The Cooperative Forest Management Act of 1950 is the basis for this cooperative program.

Under the Cooperative Forest Management Act, both farm and non-farm owners of small forests are advised and assisted in the management of their woodlands and in marketing the harvested products. The technically trained foresters who carry on this work are employed by the cooperating States. These men are called farm, service, or project foresters; sometimes they are referred to as county or local foresters. The Forest Service provides leadership and coordination for the program; it sets the standards for conducting the work and provides the necessary inspection; it apportions the Federal funds used in the program.

In fiscal year 1953 some 260 farm or project foresters were employed to handle this cooperative forest management work. These foresters assisted 32,474 woodland owners to establish better management practices on 2,827,700 acres of woodlands. Products harvested under their guidance amount to 527,419,000 board-feet of sawtimber and other forest products. In addition 192 barrels of naval stores and 160,140 gallons of maple syrup were collected. Christmas trees, holly, nuts, tree seed, pine cones, and other miscellaneous products valued at \$329,111 were harvested. The forest owners received a total of \$12,-589,543 from the sale of all these products.

Owners are referred to private consulting foresters when the prospective operation warrants such special service. During the year the project foresters referred 671 woodland owners with 425,839 acres of woodland to private practicing foresters.

The project foresters advised 6,534 small sawmill operators and processors. Services to this small operator group are still very limited. Several of the States are planning to employ processor specialists. None are yet available.

At the end of the fiscal year, the project foresters had 4,909 unfilled requests for on-the-ground technical assistance from woodland owners. In many cases these foresters are unable to reach all woodland owners requesting service, since the project areas they serve are too large for efficient operation. In a number of States there are large areas where neither a project nor a private forester is available.

General forestry assistance

While the cooperative program gives primary emphasis to the small woodland owners and their needs, the progress of forestry on industrial and other large properties is not being overlooked. Usually working through the States, the Forest Service extends cooperation by making available a few highly specialized technicians for assist-

ance. The services of these specialists are also available to advise on the management of State and community forests and of forest lands in other Federal holdings such as those of the Army, Navy, and Air Force.

Because many large private landowners have their own foresters, either on a full-time or consulting basis, the Forest Service specialists usually serve as consultants to the privately employed foresters. A good example of work being done in this field is the contribution made by Forest Service specialists in the Lake States to the development and extension of a system for continuous inventory of forest stands.

Farm Forestry Extension

The Extension Service of the Department of Agriculture cooperates with 45 States and one Territory in conducting farm forestry extension work under section 5 of the Clark-McNary Act. The land-grant colleges and State extension services participate in this educational work. The Forest Service supplies subject-matter information for the program, and in other ways cooperates in the work to promote more efficient management and harvesting of the farm timber crop.

Through its system of county agents and forestry specialists, Extension turns its efforts to problems of individual owners and groups, develops "know-how" in forestry practices on the part of owners and creates a better general understanding of the importance of forestry. In at least 12 States the State forestry departments and extension services have definite agreements for carrying on correlated programs. These understandings provide for mutual cooperation to assure the farmer of better assistance in managing woodlands and marketing his forest products.

Increasing numbers of farmers are becoming interested in such phases of forestry as windbreak and shelterbelt establishment, woodland management, marketing and utilization of forest products, production of naval stores and maple products, preservative treatment of fence posts, and mechanization of farm forestry operations with the use of power saws, planting machines, maple tapping machines, explosive wedges, log loaders, and better sawmill equipment.

The 4-H Club forestry training camps and conservation camps have increased in enrollment. Forestry projects carried out in the home woodlands and demonstration of practices at county and district meetings have provided valuable experience to club members and have stimulated considerable local interest in forestry. During 1952, 181,847 4-H Club boys and girls received training in forestry, and 613,794 in fire and accident prevention.

Cooperative Distribution of Forest Planting Stock

Total production of trees for forest and shelterbelt planting by all nurseries—Federal, State, industrial, and commercial—was approximately 462 million in 1952. Of this total, 300 million were distributed under the cooperative program authorized and directed by section 4 of the Clarke-McNary Act. This was the greatest "C-M 4" production yet achieved. Early indications for the planting year 1953 were that the C-M 4 output would exceed the 1952 figure.

The Forest Service cooperates with the States in this program to encourage and facilitate tree planting on millions of acres where planting is needed for flood control, erosion prevention, and protection of water supplies and for restoration of deforested lands to productivity. Forty-three States, Hawaii, and Puerto Rico are participating in the work.

The trees are produced in nurseries in the cooperating States and made available to landowners at moderate cost. In a number of States the amount of forest planting stock available is insufficient to supply current demand.

Increasing attention is now being given in some States to the production of planting stock from locally grown seed. In a few cases, seed of selected trees of superior form and growth rate is being used to the extent that it is available. This is a most important consideration from the standpoint of ultimate yield. Regional committees for the improvement of forest trees through seed selection have been organized in the South, the Lake States, and the Northeast. The committees operate cooperatively with a membership made up of representatives of Federal and State agencies, colleges, and industries. There is need for greater attention to seed source, however, in many other areas.

Naval Stores Conservation Program

The naval stores conservation program, which in 1952 completed its 17th year, provides assistance to gum turpentine farmers who follow conservation practices in the Southeastern States of North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi. The program is authorized by the Soil Conservation and Domestic Allotment Act and is administered by the Forest Service for the Agricultural Conservation Program.

The program is designed to encourage producers to adopt and carry out good naval stores and forestry practices. The 1952-53 program provided payments at specified rates per acre on tracts where trees were worked to a minimum diameter of 9, 10, or 11 inches. A payment was provided for selective cupping where tracts having a minimum of 50 trees per acre were cupped in a manner that would result in leaving as many trees in the stand uncupped as those which were cupped. A payment also was provided for restricted cupping. In addition to following the practices for which payments are made, a producer in order to receive any payment had to follow good timber-cutting practices and cooperate with the State fire prevention and suppression programs.

Within the active naval stores producing area, some 7,300 producers are working about 57 million longleaf and slash pine trees for the production of turpentine and rosin. The value of the 1952 naval stores crop was approximately \$40,000,000. Georgia has 75 percent of the producers and 75 percent of the timber worked. Florida has 6 percent of the producers and 17 percent of the timber; Alabama 5 percent of the producers and 4 percent of timber. The few score remaining producers are in Mississippi, North Carolina, and South Carolina.

In the 1952-53 season, 3,137 producers participated in the program with 45 million trees, and received a total of \$480,000 in conservation

payments. Comparable figures for the preceding year were 3,319 producers and 49 million trees, and payments of \$477,000.

The Soil Conservation and Domestic Allotment Act does not permit conservation payments for naval stores practices on Federally owned land. On the national forests, 350,000 trees were worked by 23 producers in 1952. These trees were worked under leases containing the same specifications as those in the naval stores conservation program.

The naval stores conservation program has resulted in the adoption of chemical stimulation by an increasing number of producers. This technique, developed by the Forest Service, stimulates and prolongs the flow of gum. It saves much labor; trees can be worked longer; and the loss that occurred from deeply scarred faces when the old wood-chipping system was used is reduced or eliminated. Only 5 percent of the producers used the chemical stimulation treatment on 6 percent of the faces in 1949. In 1952 30 percent of all gum turpentine producers in the naval stores belt used chemical stimulation on 40 percent of all faces.

Cooperative Fire Control on State and Private Forest Lands

For most of the States, 1952 proved to be an unusually severe fire year. For Kentucky, Virginia, West Virginia, Tennessee, Illinois, Mississippi, Louisiana, and Alabama especially, it was a year of very heavy losses.

Reported fires on State and private protected lands numbered 118,363, while an estimated 60,280 fires occurred on unprotected areas. The total of 178,643 fires was nearly 15 percent greater than that of the preceding year.

On protected State and private forest lands, fires burned 6,347,227 acres or 1.72 percent of the area. This was more than double the acreage loss of the preceding year (an increase of 108 percent). On unprotected lands, according to the best estimates available, 7,559,232 acres were burned, or 13.03 percent of the total lands unprotected, compared with 11.46 percent for the preceding year.

The bad fire danger conditions that prevailed were reflected in a substantial increase in the nationwide average of area burned per fire on protected areas. This average in 1952 was 53.6 acres, compared with a 1951 average of 31.4 acres.

58 million acres still unprotected

The Forest Service cooperated last year with 43 States and Hawaii in the protection of non-Federal lands from fire, under authorization of the Clarke-McNary Act. The cooperative program, now in its 42d year, is given overall direction and leadership by the Forest Service, which allocates the Federal funds among the participating States, audits the expenditures made by the States under the program, coordinates the objectives and efforts of the States' protective organizations, inspects the adequacy of the work, compiles records, and facilitates exchange of information on fire-control equipment and techniques.

Cooperative protection was extended during the year to an additional 5,278,000 acres under this program. Of the 426,694,000 acres of State and private forest and watershed lands needing protection in

the United States, 368,692,000 acres are now under protection. But more than 58,000,000 acres remain without any systematic protection.

The protection forces in many of the organized areas are still not strong enough to cope successfully with a really serious or a prolonged fire season, such as occurred in 1952. The protection effort needs to be strengthened in manpower and equipment, and bolstered by more intensive preventive activities.

Expenditures

During the fiscal year 1952 (latest available figures) the States and private owners spent \$26,636,876 in the cooperative protection program. The Federal Government made available to the States \$8,960,230, making a total of \$35,597,106 expended in the program.

In addition to the expenditures in the cooperative program, local governments, private timber owners and operators during calendar year 1952 spent over \$16,000,000 for special fire-control equipment, improvements, and services.

Prevention of fire

For the past decade the Forest Service and the State forestry departments have jointly carried on a Cooperative Forest Fire Prevention program, with the very active cooperation of The Advertising Council, Inc. Under sponsorship of this Council, the advertising firm of Foote, Cone and Belding has given much time and effort to the program as a public service. The program, which features "Smokey," the fire-prevention bear, has served to publicize nationwide the need for forest-fire prevention. There remains a great deal that must be done in direct prevention effort with local groups, if man-caused forest fires are to be effectively reduced. A review of the reported causes of fires emphasizes this need.

Consistently over the past several years the major causes of forest fires have been incendiarism, debris burning, and smokers. Last year was no exception: 35 percent of the fires on protected lands were of incendiary origin; debris burning caused 22 percent, and smokers 20 percent of the total number of fires. Other causes were neglected campfires, lumbering and railroad operations, and miscellaneous. Lightning caused only 6¼ percent of the fires nationwide, although it caused a higher proportion of those occurring in the national forests of the Western States.

Cooperative Forest Pest Control on State and Private Lands

The Forest Pest Control Act of 1947 authorized a broad program for the control of destructive insects and diseases attacking the forests. The Secretary of Agriculture in 1952 asked individuals representative of the various phases of forestry to serve as consultants on questions arising in connection with the Department's activities under this act. The advisory group of six members met in May 1952 for the purpose of organizing, and again in December to review the present situation, to discuss policies, and suggest approaches to surveys, research, and control.

The Secretary of Agriculture is authorized by the Forest Pest Control Act to cooperate with the States and private landowners in insect and disease control on non-Federal lands. State Foresters are

taking an increasingly active part in the detection and control of forest pests. The Association of State Foresters at its meeting in 1952 created a Forest Pest Committee of five members to guide and advise on policies and action regarding forest insect and disease control, primarily on State and private lands.

Several States have enacted legislation which enables the State Forester to cooperate effectively in projects for control of insects and diseases. A few of the State forestry departments have been active in control work for several years. Many States are hampered, however, by lack of suitable authorization to do control work on private lands.

In some of the States, organized detection service has been set up in which the State Foresters' field organization, industrial foresters, and other field foresters participate. The cooperating field foresters provide good coverage through observations as they carry on their usual activities. There is need for additional training for these men, however, to help them spot infestations in their early stages.

The formation of local or statewide forest pest control committees has proved to be effective in developing coordinated forest pest control action, particularly where small private ownerships are involved.

Flood Prevention

The Secretary of Agriculture's Memorandum 1325 effected certain changes in assignment among agencies handling flood-prevention activities in the Department under authorization of the Flood Control Act of 1936 and its later amendments. The Forest Service's responsibilities include the making of preliminary examinations and surveys, the installation of works of improvement, and collaboration in river basin reports, on all national forests, on range areas adjacent to national forests, and on all other forest lands within a watershed or basin. The Forest Service cooperates and enters into agreements with and utilizes the services of State forestry agencies for these purposes, when State and private forest lands within a watershed or region are affected.

In 1953 Forest Service work on flood-prevention surveys in upstream watersheds was substantially curtailed. The personnel engaged in this work was reduced by 40 percent below that assigned to the work in 1952. Three upstream watershed flood-prevention surveys were completed, however, and reports submitted to the Secretary of Agriculture during the year. These covered the Santa Ana River-San Gabriel River and the Santa Clara River-Ventura River-Callegras Creek groups of watersheds in California, and the Virgin River watershed in Utah, Arizona, and Nevada. Field work was completed during the year on flood-prevention surveys for three additional groups of watersheds—the Salt River in Kentucky, the Merrimac in New Hampshire and Massachusetts, and the western-slope streams of San Diego County in California. In addition to these, work was in progress on 10 other flood-prevention surveys under Forest Service direction, and the Forest Service also collaborated with the Soil Conservation Service on forest-land phases of 20 flood-prevention surveys for which that agency was responsible.

River basin programs

The Forest Service continued its cooperation with other Department of Agriculture agencies and with the land-grant colleges in preparing a comprehensive program for the development of the agricultural and land resources of the Columbia River Basin.

Early in the year, House Document No. 530, "Supplemental Report, Missouri River Basin Agricultural Program," was released. This document included material contributed by the Forest Service working cooperatively with other Department agencies in the Missouri Basin.

In the Arkansas-White-Red River Basins and in the New England-New York States the Forest Service continued to work with other Federal agencies and with the States in developing comprehensive and integrated programs for flood prevention and the conservation and utilization of land, water, and related resources.

Progress on flood-prevention projects

Work continued in each of the six project areas in which the Forest Service is participating in flood-prevention work, as authorized in the 1944 Flood Control Act. In cooperation with the States concerned, fire-protection measures have been installed in the Coosa (Georgia) and Potomac (Virginia and West Virginia) River watersheds. A special plan to guide and expedite fire suppression was completed for the steep, hazardous brush areas in and adjacent to the Angeles National Forest, in the Angeles River watershed in California.

Installation of the fire-protection improvements authorized in the flood-prevention program is almost completed in the Santa Ynez River watershed in California. These improvements are located in the mountain area above the Cachuma Reservoir now nearing completion. The improvements are designed to afford increased protection to the reservoir from sedimentation, by maintaining an unburned, soil-stabilizing plant cover on the watershed.

Intensified fire-protection measures in the Los Angeles and Santa Ynez watersheds include the use of highly trained, fast-moving crews, which have quickly suppressed many fires before they could become major conflagrations.

In Mississippi organized fire protection has been extended through Federal-State cooperation to all but four counties in the Little Tallahatchie-Yazoo River watershed. In these four counties much work has been done to help the citizens obtain countywide fire protection. Flood Prevention Project foresters have cooperated directly with the State Forester in suppressing fires, and in training emergency fire crews to be available and effective during critical periods of fire danger. The rate of tree planting to reduce erosion in these watersheds is expanding to the limit of available planting stock. Nearly 25,000,000 trees were planted during the 1952-53 season. Most of this planting was done on privately owned lands with the cooperation of landowners and timber operators. Voluntary fire protection is improving as tree planting increases and landowners recognize the long-term values in their tree plantings. The application of good forest-management practices, guided by project foresters, is gradually

increasing, and the importance of this work to landowners and its relationship to flood prevention is being recognized more widely each year in the watershed area.

FOREST RESEARCH

Twenty-five years ago, recognizing the vital need for sound knowledge in meeting the forest, range, and watershed problems of the United States, Congress passed the McSweeney-McNary Forest Research Act of 1928. This act authorized and directed the Secretary of Agriculture

"... to conduct such investigations, experiments, and tests as he may deem necessary . . . to determine, demonstrate, and promulgate the best methods of reforestation and of growing, managing, and utilizing timber, forage, and other forest products, of maintaining favorable conditions of waterflow and the prevention of erosion, of protecting timber and other forest growth from fire, insects, disease, and other harmful agencies, of obtaining the fullest and most effective use of forest lands, and to determine and promulgate the economic considerations which should underlie the establishment of sound policies for the management of forest land and the utilization of forest products . . ."

This broad-gage directive has been the charter for the development of a nationwide forest and range research program that has continued to gain momentum during these 25 years. Under this program, the Forest Service now has in operation a national system of 11 regional forest and range experiment stations in the United States, a research center in Alaska and a tropical forest research center in Puerto Rico, and a national Forest Products Laboratory in Madison, Wis.

The McSweeney-McNary Act is also a charter for cooperation in the research program. As forestry has become a going, profitable business and the need for a scientific basis for sound forest, range, and watershed protection and management has been recognized, there has been more and more cooperative participation by State and local agencies and private organizations and companies in forest research projects.

Local and regional advisory committees utilized over the years, together with a recently established National Advisory Committee, are functioning to stimulate cooperation and to assure desirable balance and coordination in the research program. Advisory committees have emphasized the need for research to serve the various phases of multiple-use forest management.

Forest-Management Research

The forest-management research program of the Forest Service is aimed at improved forest production. First of all there is a search for new scientific facts related to the growing of trees and forests; and secondly, a testing of the practical application of these findings to the actual operation of forest properties. The examples of advancements made during the past year given in the following paragraphs illustrate the broad front over which this research program operates.

Seed dissemination gives clue to desirable cutting methods

First-year results of seed-dispersal studies on the Coram Experimental Forest in Montana showed that both larch and Douglas-fir seeds were scattered a maximum distance of 660 feet from the closest timber. However, dispersal was insignificant in quantity beyond 260 feet for Douglas-fir and 400 feet for western larch. These early results came from clear-cutting tests aimed at determining the maximum sized opening that will restock satisfactorily within a 5- to 10-year period.

In another study—this one in lodgepole pine, also in Montana—the dispersal of seed more than 250 feet beyond a timber edge was found to be very limited. Not more than 6 percent of the seed was dispersed farther than 70 feet from timber into clear-cut openings. Thus clear-cut strips which depend upon seeding from the sides must be narrow (probably not to exceed 130 feet) for adequate lodgepole pine seed dissemination.

The distance of effective seeding in the Douglas-fir region of Washington was determined by recording the reproduction obtained in small group cuttings as compared with a large clear cutting. Seedling counts made 5 years after logging point out that excellent regeneration resulted from the small group cuttings, but that for the large clear-cut tract, satisfactory seeding was confined to parts of the area within 500 feet of the timber edge. Hemlock was more widely distributed than Douglas-fir.

Seed-dissemination studies are also being carried out in Arkansas. Sweetgum seed does not travel as far from the parent tree as many people believe. The Arkansas findings have at least two practical applications. Where hardwood-control measures are being carried on to favor the pine component of pine-hardwood stands, all seed-bearing sweetgum should be eliminated from the stand and in a border zone of 600 feet. On the other hand, where a harvest cutting of sweetgum is being made to reproduce the forest on soils well adapted to that species, sweetgum seed trees should be spaced not much farther apart than 100 feet.

Reducing windfall losses

Severe storms of the past few years have demonstrated in no uncertain terms that windfall can be a major cause of mortality in forest stands. On the Oregon Coast Range alone, one storm in December 1951 blew down 3.7 billion board feet of merchantable timber.

During 1952, a preliminary study of the pattern of windfall was carried out at the Cascade Head Experimental Forest and at other locations in the Oregon Coast Range to explore management methods that will minimize windfall losses. The findings provide good evidence that wind damage associated with clear cutting can be greatly reduced in the Coast Range by using a modified "progressive strip cutting" system, by minimizing or eliminating exposed north and east cutting boundaries, and by carefully selecting windfirm cutting lines.

A study of different methods of logging spruce-fir stands on the Fraser Experimental Forest in Colorado has shown that windfall, the greatest source of damage to cutover timber, can be reduced by as much as 100 board feet per acre per year. Removing groups of trees rather than cutting by a uniform individual-tree-selection system—the

method commonly used in the past—not only leaves timber more wind-firm but is followed by a greater quantity of natural regrowth.

Forest tree improvement

Increasing competition for high-quality timber brings into sharp focus the need for full productivity of forest land. As a result, reforestation of idle land proceeds at an increased tempo. The demand for planting stock can only be satisfied with correspondingly large quantities of seed which, quite naturally, are usually obtained where most abundant and cheapest. Cones are often collected only from the prolific seed-producing trees that are easiest to climb, without regard to vigor, quality, or disease resistance of the parent trees. This practice, plus the "high-grading" of natural stands for the best trees, leads to degeneration of the crop. Thus landowners while stimulating reforestation efforts at present may be penalized in the future by the slow growth of inferior stands.

The genetic quality of the present forests can be maintained and those in the future improved by (1) establishing new stands by planting with seed from the best trees in the best stands adapted to a given locality, (2) making tests, with seed or grafted material of the best trees, stands, and races, to determine the best types and (3) starting a program of tree breeding to create new types.

Several years ago the Southern Forest Experiment Station demonstrated that serious losses in potential growth rate of planted loblolly pines resulted from using seed too far from its point of origin. For example, seed collected several hundred miles away and planted at Bogalusa, La., gave plantations that yielded only 40 percent as much wood as plantations from local seed. A knowledge of the correct geographic races to plant in different areas may bring very large rewards in timber yields. In order to determine the safe limits, a cooperative seed-source study was started in 1950 and carried through to field planting in 1952 with longleaf, slash, loblolly, and shortleaf pine from all parts of the South and Southeast. This study, carried out under the sponsorship of the Southern Forest Tree Improvement Committee and supervised by the Southern Forest Experiment Station, involves a total of some 300 private, State, and Federal co-operators, 16 Southern States, 19 nurseries, and 57 outplanting locations. This is perhaps the largest seed-source study ever undertaken in the world.

The attempt to obtain better strains of slash, longleaf, loblolly, and shortleaf pine through individual tree selection is being carried out in cooperation with the Ida Cason Callaway Foundation in Georgia. Progeny of some outstanding mother trees, even though the male parent is unknown, are as much as 50 percent taller at the end of one growing season in the nursery than those from other trees from seed of commercial source. Likewise 1-year-old western white pine progenies of known parentage have been found to reflect inherent vigor of their parents. The latter tree-breeding studies, aimed at improving disease resistance, growth, and form, are being conducted at the Northern Rocky Mountain Forest and Range Experiment Station by the Forest Service in cooperation with the Bureau of Entomology and Plant Quarantine and the Bureau of Plant Industry, Soils, and Agricultural Engineering.

At Lake City, Fla., evidence just obtained shows conclusively that the yield capability of oleoresin, the source of naval stores products, is an inherited character in longleaf pine. This study, begun in 1935, indicates the long-term nature of some phases of forest genetics work and emphasizes the need for an early attack on fundamental problems.

At the Institute of Forest Genetics of the California Forest and Range Experiment Station, the breeding program has produced more than 70 different hybrid combinations. In its work of exploring and exploiting the genetic variability of the different pine species, new crossings are attempted each year. Last year some 49 different species combinations were attempted, including 30 first generation crosses, 4 backcrosses, 7 three-species crosses and 2 four-species crosses. Thus almost one-third of the new crossings used hybrids as one of the parents. As more and more hybrids come into flower bearing, the percentage of such crossings will increase.

Converting poor hardwood stands to pine

It has long been recognized in agriculture that maximum farm income can be obtained by growing crops best suited to the soil and climatic conditions present. Certain crops do best on light sandy soils, others do best on heavy soils. When a variety of growing conditions occur on a farm the wise farmer plans his crops to make the most of his land.

The wisdom of such practice has also become apparent in forestry. In the widespread Central Hardwood Region of the United States, the oak-hickory forests occupy many different kinds of soils. On some they do well and produce valuable stands. On others, especially the more sandy soils, the ridge tops, and drier situations, they yield little although they occur there naturally. Moreover, low-grade hardwoods are abundant but softwoods are in short supply; hence there is an urgent need to find suitable softwoods that can be grown on the land. Studies by the Central States Forest Experiment Station are showing that pines can be planted and will make good growth on soils where the hardwoods do poorly. The problem is to find the right species and strain for a locality, a tree that is hardy and disease resistant. Progress has been made in introducing pines from adjacent areas. Such introductions have not always been free from insect and disease attacks and, as recent results in Arkansas show, it is highly desirable to get seed from comparable climatic zones. All this suggests the need for studies of genetics and tree breeding in order to develop thoroughly satisfactory strains for this region.

Research in Forest Fire Control

Improving the protection of wild-land values from fire through use of modern technology is the purpose of the Forest Service's program of forest-fire research. The rapid increase in commercial values of productive timberlands and the vital importance of forests for watershed protection call for more intensive methods in protecting these valuable properties. Federal, State, and private protection agencies are in great need of more technical information for use in improving the effectiveness of their services.

During the past year a number of investigations were under way to help fire-control officials anticipate the size of the fire-fighting

job at all times. Statistical studies were continued, designed to bring out the lessons to be learned from past experience with various methods, policies, and systems of fire control. Other investigations included studies of fire damage to permit better appraisal of losses; experiments in maintaining firebreaks by use of chemicals, and development of methods for systematically testing the efficiency of fire equipment in different combinations.

Some highly technical studies were made on the thermal and other physical qualities of common forest fuels, to establish exact relationships and to bring about a better understanding of just when and how they become extremely susceptible to fire.

Progress in various phases of these activities was reported in 14 reports or publications issued during the year.

New cooperative studies

A new project undertaken in cooperation with the State universities, State foresters, and private forest-protection associations in Idaho, Montana, and Washington looks to the development of better methods of reducing fire hazards from logging slash, and other measures to provide better protection for cutover lands in the Northwest.

A cooperative project also has been started with the Munitalp Foundation, Inc., to study the nature and development of fire-setting lightning storms in northern Idaho. The Weather Bureau is cooperating in investigations on the effects of unstable atmospheric conditions on the spread of fire. During the year new evidence was found that the condition of the atmosphere in the vicinity of a fire can have a pronounced effect on how fast the fire spreads. The investigations under way give promise that dangerous atmospheric conditions eventually can be predicted in advance, once their makeup and effect have been fully established.

Forest and Range Influences

The influences-research program of the Forest Service includes both basic and applied research. Basic research is primarily concerned with discovering the physical and biological processes that affect the interrelations of soil, plants, and water. Applied research involves studies to determine answers to such questions as the specific effects of land-use practices on the behavior of watersheds and the best methods of stabilizing damaged areas. It also includes the design and testing of improved cutting, logging, grazing, roadbuilding, and other practices to reduce harmful erosion, flood flows, and debris movements, and to increase the yield and quality of water supplies.

Runoff and streamflow reflect watershed recovery

Significant changes in streamflow have occurred over the past 15 years on two small watersheds in Utah's Wasatch Mountains. During the disastrous mud-rock floods in 1930, Parrish Creek, which leaves the mountains near the valley town of Centerville, was scoured to bedrock. From 1936 to 1942 it yielded about 1 inch more annual flow than adjacent Centerville Creek. Since then, however, its flow has decreased to about 1 inch below that of Centerville Creek. Scientists attribute the change in relative flows to the increasing use of water by the vegetation which has come back along the previously scoured channel of Parrish Creek.

Well-stocked forests favor more snow and slower melt

In the Northeast, where snowfall is often heavy, well-stocked forests appear most effective in promoting favorable water yields and reduced flooding. The greatest amount of snow accumulates in well-stocked hardwood stands. Second greatest is on abandoned lands and former clear-cut areas containing a dense cover of small trees or brush; third, in spruce, balsam, or pine stands; fourth, on hay and pasture lands; and the least amount on bare, cultivated fields. The rates of snow melt, however, appear lowest under conifers, next under hardwoods, and highest on open fields. The soils of ungrazed, lightly cut hardwood forests also are comparatively free of types of frost that prevent melting snow from percolating readily into the ground. On the other hand, the "concrete" frost that usually occurs in open fields obstructs percolation, causing rapid surface runoff of melting snow and spring rains.

More light on watershed logging

Timber operations in California have often caused serious surface runoff and erosion hazards due to the logging roads, equipment, and skidding practices employed. Research workers are cooperating with national-forest officers in preparing a guidebook showing how to recognize potential hazards in advance so that less damaging methods can be applied. This guidebook will be based partly on detailed observations of logging operations, and partly on the results of basic investigations into the effects of land-use activities on soil and water relations.

Special cutting practices aid fishing

That partial removal of streambank forest growth may actually improve the habitat for fish is indicated by experiments now under way in cooperation with the State Fish and Game Department of North Carolina. After the felling of trees in one case and only the undergrowth in another case, water temperatures remained within optimum limits for fish life. On minor watercourses that are too small to support fish, the increased temperatures and sunlight that result from the partial removal of vegetation may stimulate the growth of aquatic organisms. These organisms are washed down to the larger streams and furnish increased food for trout.

Facilities at the experimental areas where forest influence studies are conducted are especially suited to cooperative projects with State fish and game departments. Such projects are welcomed by the Forest Service because they lead to a more practical understanding of the multiple-use possibilities of forest and range management.

Denuded lands successfully revegetated

Years ago, fumes from copper smelting killed all the plant growth on large areas of once-forested steep slopes above the Bureau of Reclamation's Shasta Reservoir in northern California. The resulting sedimentation has threatened the usefulness of this giant storage reservoir. During the 1930's ponderosa pine and other trees were planted in an effort to stabilize the shifting granitic soils. Later, small brush dams were placed in the gullies. Recent examinations show that the soil within the tree plantations has largely been stabilized beneath a matted litter of pine needles. But on adjacent unplanted sites the

natural growth of manzanita and other native shrubs has not been sufficient to protect the soil and consequently many gully bottoms are filled with eroded materials and the sides of the gullies remain exposed to further soil losses.

Tree planting has thus proved its worth for reclaiming the 32,000 acres that still remain unprotected.

New method improves flood predictions from treated watersheds

The effects of watershed-improvement measures on floods can now be predicted more accurately by a method devised by Forest Service hydrologists and foresters in the Northeast. Starting with records of previous rainfall and flood discharges, the amount of rainwater that actually enters the ground and passes through the several layers of the soil is determined by soil-moisture sampling. The comparisons of treated and untreated areas consider such factors as the amount of soil moisture already present before precipitation, the losses of water by evaporation and plant use during given storm periods, and the variations among the different soil layers in their ability to store and pass excess water downward into the streams. The difference between the amount of rain that reaches the ground and the net amount that enters and passes through the soil represents the volume of flood-contributing surface runoff. This runoff is then related to the rise in streamflow as recorded by the stream gage. The method has now been adopted by the New England-New York Inter-Agency River Basin Committee as a standard technique for evaluating the flood-reduction effects of watershed-improvement programs.

Cooperative relations

At the request of the Conservation Foundation, the Forest Service loaned a research specialist to that organization to prepare a semi-technical book bringing together the knowledge on the basic relations of vegetation and water yield for each major climatic and soil region of the United States. This book is scheduled for publication early next year.

Hydroelectric power companies, municipalities, and industries continue to request technical advice on the management of their watershed lands to better attain regulated flows and high-quality supplies. Requests for assistance by the Department of the Interior's land-managing agencies are being met to the extent that funds permit. The soil-moisture investigations conducted at several localities in cooperation with the Army Corps of Engineers continue to provide information of fundamental value.

Range Research

Cooperative approach to California brush problem

Cooperative research of the Forest Service, the University of California, and the State of California has combined specialized training along several different lines towards developing better methods of converting low-value brush fields to grass. The program is aimed at improving forage production while also maintaining a protective vegetation on watersheds to prevent serious soil erosion.

Research to date shows that soils typically associated with woodland-grass vegetation can be improved by burning with ample provi-

sion for revegetation. Soils associated with chamise-chaparral vegetation, especially shallow soils on steep south slopes, do not respond as well to such treatment for revegetation. "Area ignition" and "brush mashing" techniques have been developed, making it possible to obtain clean, orderly burns in periods of low fire hazard. Species and methods have been found for quickly restoring a cover of vegetation that will give a high forage yield, give ample soil protection, and control brush seedlings.

Big game and livestock

Cooperative studies of forage use by big game are providing information necessary to integrate the management of deer and elk herds with management of livestock and other uses of the land. The urgent need for such information is shown by studies of 58 deer herd ranges in Utah. It was found that 38 of these had problem areas where important deer forage had been depleted by overgrazing, either by deer, by livestock, or by both kinds of animals.

The Utah studies showed that the deer compete with both cattle and sheep for forage. Here grass, mostly bluegrass, a valuable forage for livestock, was found to make up 90 percent of the spring diet of mule deer. Forbs and browse were the main summer diet, the forbs being most important in early summer while they are still succulent. After midsummer, browse use exceeded forb use. During fall and winter, browse was the main diet, more than 80 percent of it being composed of sagebrush, cliffrose, and bitterbrush.

In Oregon a 7-year study gave tentative levels for the proper winter use of several important browse species on big-game ranges. The results suggest how much of the current growth of snowbrush, ceanothus, curleaf mountain-mahogany, antelope bitterbrush, and other browse plants can be utilized on good sites and on poor sites without depleting the browse forage.

In California the State Department of Fish and Game and the Forest Service have started cooperative studies to develop methods of restoring browse species on ranges where they have been depleted. Methods of seeding bitterbrush are also being tested cooperatively by the Forest Service and the Idaho Fish and Game Department.

Improvement of salt desert-shrub ranges

Eighteen years of grazing-management research at the Desert Experimental Range in Utah have developed management methods that can greatly improve forage production and double the net income from sheep that graze salt desert-shrub ranges. The better stand of vegetation resulting from proper management makes possible greater wool production, higher lamb crops, and lower death losses, all of which contribute to greater income for the sheep operator. The better vegetation also resists the invasion of undesirable plants such as Russian-thistle and small rabbitbrush. The research results apply in varying degrees to 42 million acres of salt desert-shrub ranges in the West, which provide 6 months of winter grazing each year for 4 to 5 million sheep. The recent widespread invasion of these ranges by halogeton, a plant poisonous to both cattle and sheep, has focused attention on the importance of these lands and the need for their improvement.

Reseeding rangelands in the Southwest

Guides to the use of crested wheatgrass for seeding rangelands in the Southwest have been published in Farmers' Bulletin No. 2056. Crested wheatgrass has had wide use in cooler sections of the West but only limited use in the Southwest. It has been found adapted, however, and is recommended for seeding depleted areas throughout the ponderosa pine range area. It may also be successfully seeded on better sites in the pinyon-juniper and big sagebrush range types. Grass yields range from 520 pounds of air-dry herbage per acre on poor sites to over 1,000 pounds per acre on the better sites. Grazing studies on ranges reseeded to crested wheatgrass in New Mexico show that a degree of grazing that removes about 35 to 55 percent of the current herbage growth results in average daily gains for the cattle of nearly 2 pounds per head, while preserving the stand of grass. This is considerably more beef than can be obtained on unseeded depleted range in the same area.

Control of undesirable range plants

Results of past research on the mesquite problem in the Southwest have been summarized and published as Department of Agriculture Circular No. 908. Mesquite occurs on some 70 million acres of rangeland in the Southwest. It is estimated that over half the rangeland now occupied by mesquite has been invaded since 1850. Also, the original stands have become thicker. Mesquite advance is attributed to a combination of influences, including cessation of range fires, heavy grazing, drought, and dissemination and planting of seed by livestock, birds, game animals, and rodents. Mesquite control offers good possibilities as a range-improvement measure. On a range with moderate precipitation and a good stand of perennial grasses, killing velvet mesquite was found to double the yield of the grasses within 3 years. Mesquite can be economically controlled through grubbing or hand application of sodium arsenite or petroleum oils. Herbicides such as 2,4-D and 2,4,5-T show promise, but further studies are needed to determine more selective chemicals and techniques of application.

Forest Economics*The Forest Survey*

Timber-production plans and programs of the Forest Service, and those of other public agencies and private timber owners and operators, require basic facts on timber supplies, timber growth and mortality, timber cut for lumber and other products, and prospective needs for timber. Such information is obtained by the Forest Survey.

Since the Survey was started in 1930 a total of 450 million acres, or more than two-thirds of the estimated 622 million acres of forest land in the United States, has been initially covered in the field for detailed forest-resource information. Since 1946, 167 million acres of forest land also has been covered by resurveys to bring older surveys up to date in the most actively logged areas, such as the South and Pacific Northwest. These resurveys have shown varying trends in the timber-supply situation in different States.

During fiscal year 1953, initial surveys covered about 26 million acres of forest land in California, Idaho, Indiana, Ohio, New York,

Pennsylvania, West Virginia, and Maryland. Resurveys covered about 36 million acres in Oregon, Washington, Minnesota, Wisconsin, Michigan, Alabama, Louisiana, Texas, Georgia, and North Carolina. Cooperating public and private agencies in eleven of these States gave substantial financial or other assistance in speeding up and intensifying the Forest Survey. State analytical or statistical reports were issued for Arkansas, Indiana, Kentucky, West Virginia, Tennessee, and Vermont.

Special economic studies

A study concerning the feasibility of establishing pulp mills in eastern Montana indicated that there is sufficient timber in the national forests of this area and suitable water supplies east of the Continental Divide to support the permanent operation of several pulp mills. Development of pulpwood resources in this area, however, would require intensification of forest management, the construction of many miles of timber access roads, and measures to guard against water pollution.

A study of financial maturity of shortleaf and loblolly pine in Arkansas and Louisiana indicated the gross and net values of trees of different classes, timber-production costs, and rates of value increase for trees of different vigor classes utilized for sawlogs. From these data simplified marking rules for use in the woods have been established. The study showed that trees that are improving in grade or log length usually are not financially mature until the growth rate declines to a very low point or trees reach at least 25 inches in diameter.

In the Southeast, a study was begun to determine the economic feasibility of marketing logging waste and sawmill residues for pulpwood, including determination of the most efficient methods for utilizing and transporting such material. In an area in South Carolina selected for study, 50 thousand cords of mill waste suitable for chipping and 36 thousand cords of logging waste were produced annually through the operations of 147 sawmills. Logging waste ranged from 0.3 to 3.2 cords per acre. An analysis to determine minimum operable volumes is now under way.

In order to help the small timber owner and those who advise him on tax problems, the Forest Service published Agriculture Handbook No. 52, "The Small Timber Owner and His Federal Income Tax." In nontechnical language, this handbook describes the ordinary-income and capital-gains methods of reporting receipts from sales of timber and forest products, tax treatment of timber losses from fire or other casualty, and the treatment of the costs of forest ownership and operation.

Forest Products

The forest-products research program of the Forest Service, centered at the Forest Products Laboratory in Madison, Wis., seeks to develop new products, to lower the costs and improve the serviceability of existing forest products, to find ways to reduce the amount of unused residues in forest and mills and find useful outlets for unavoidable residue, and to aid in the solution of national, regional,

and local forest products problems of all types. Some examples of the past year's activities follow.

Fundamental approach to semichemical pulping factors

A fundamental approach has been made to the problem of classifying various woods with respect to their semichemical pulping behavior. In this study pulping data on a number of woods were classified and analyzed. The main variables—the properties of the wood itself, and its pulping characteristics and pulp yield—were used to develop a “pulping index.” Further development of the index will make it possible to predict the semichemical pulping behavior of any wood without actually making lengthy and costly pulping tests.

Heating veneer logs electrically

Hardwood veneer logs must usually be heated before they are cut into veneer. This heating is costly and time consuming, requiring 1 to 2 days or more in steam or water. Softwood logs are usually cut without heating, in the interest of economy, but here too, the improved quality of the veneer obtained from heated bolts makes heating desirable whenever it can be justified economically. A promising new method of heating veneer bolts quickly and economically has been developed. A high-voltage electric current is passed through the green bolts, which are heated because of the resistance to the passage of the current. Bolts requiring 2 days of heating in steam or water have been heated throughout in 2 to 4 hours by the new method. The cost of electrical heating is low—another advantage.

Strength of wood at low temperatures

Assertions have frequently been made that wood becomes weak and brittle when continuously exposed to very low temperatures. Recent Laboratory investigations at temperatures as low as -300° F. disprove this. In fact, some important strength properties of wood are increased, compared with those at room temperature. Increases range from 40 to 150 percent depending on the property and the species involved. Fundamental knowledge of the behavior of wood at very low temperatures is applicable to the use of wood for construction, containers, and shelters in the arctic regions, and for such nonmilitary uses as wood supporting members and insulation for tanks carrying liquefied gases at -275° F.

Preservation of wood in glued products

Glued wood products in the form of plywood, laminations, and other built-up products are being used more and more under adverse conditions of exposure. This has created the need for information both on the preservative treating of glued material and on the gluing of treated wood. The Forest Products Laboratory tested products glued with several common synthetic-resin adhesives and subsequently treated. Seven different commercial wood preservatives and one fire retardant, applied by pressure, had no harmful effects on the strength and durability of the glue bonds. The glue joints were evaluated shortly after treating and again after 2 and 6 years of aging.

Progress has also been made in developing techniques for gluing wood that has first been treated with preservative. The Laboratory

demonstrated that treated wood can be successfully glued, and devised a practical method of producing thoroughly treated glued-up members for service under conditions of high decay and insect hazard.

Fire hazards in houses

Fire hazard to human life is closely associated with the rate at which flames spread through a burning building. A method of testing the rate of spread of flame over the surface of combustible materials is being developed at the Laboratory. The results of these studies will have a very practical bearing on building-code specifications of materials and the fabrication of construction materials less hazardous to human life. They are particularly important in connection with the Nation's housing program.

Simplified house paint maintenance

A house paint maintenance study on representative exterior paints and painting systems that was started in 1936 has reached a significant stage. The results reveal that painting too frequently or too generously produces paint films of excessive thickness. Excessive film thickness, in turn, causes such excessive checking, scaling, and peeling that complete and expensive removal of the old paint is necessary. These findings are of importance in two respects. They indicate repainting schedules that should result in decreased painting cost and improved paint service to the householder. They also indicate means of evaluating paint service in shorter periods than the 16 years required for this study.

Double-diffusion treatment of cooling towers

The cooling tower is an important link in many industrial operations. In some cases repair and replacement of cooling tower parts has been necessitated by early decay as well as by chemical deterioration. Where decay is the cause of deterioration, the double-diffusion method of preservative treatment seems to be a logical method, if not the only practical method, whereby cooling towers may be effectively treated in place. During the past year the Forest Products Laboratory cooperated with a manufacturer and two users of cooling towers in experimental double-diffusion treatments in which first one chemical and then another was flowed over the wood in water solution to react and form a water-insoluble preservative compound. Samples of the treated wood removed and analyzed for preservative retention showed fair penetrations in new unweathered pieces and good penetration in older pieces that had been in service for a number of years. From time to time additional samples will be removed to determine the permanence of the treatment under normal cooling tower service conditions.

The entire cost of the double-diffusion treatment was about 7 percent of the replacement cost of the cooling tower. Replacement cost may run as high as a quarter of a million dollars. Service life varies from 4 years under severe conditions up to 20 years; failure after about 7 years of service is common. With a service life in this range only a very moderate extension of life would make treating profitable.

The double-diffusion treatment developed by the Forest Products Laboratory was originally intended for use on green fence posts.

ADMINISTRATIVE MANAGEMENT AND FISCAL CONTROL

Organizational changes

An organizational study resulted in decision to combine 14 national forests and consolidate offices, in order to obtain greater economies in administration and more effective utilization of improved transportation and communication facilities. Steps already have been taken to effect these combinations. Three of them were well along toward completion as this report was prepared: the supervisors' offices of the Pisgah and Nantahala National Forests in North Carolina to be consolidated; the Minidoka National Forest to be combined with the Sawtooth National Forest in Idaho; and the Crook National Forest to be eliminated and its lands added to the Coronado, Tonto, and Gila National Forests in Arizona and New Mexico.

It was also decided to combine the Southwestern Forest and Range Experiment Station, which had headquarters at Tucson, Ariz., with the Rocky Mountain Forest and Range Experiment Station with headquarters at Fort Collins, Colo. An important research center will be maintained at Tucson.

In two of the Forest Service regional offices, combinations of divisions have been made for greater economy. Further savings should result from many other smaller organizational changes.

Fiscal Service

The Forest Service at the beginning of the year embarked on an intensive program to improve its fiscal management. Forest Service members worked closely with the Secretary's Office, the General Accounting Office, Treasury Department, and others. Studies in accounting operations, methods, and procedures are resulting in more efficient administration at less cost. Internal audit and controls have been strengthened. These studies will be conducted on a continuing basis in all fields of fiscal and accounting work and further improvement in efficiency is expected.

Statement of Receipts and Expenditures

National forests

Receipts from the national forests deposited to the forest reserve fund in fiscal 1953 amounted to \$74,732,468. In addition there was collected \$1,524,009 from national-forest lands that were within the former indemnity limits of the grants to the Oregon and California Railroad Co., and \$207,269 from Tongass National Forest in Alaska, both of which were deposited in suspense pending proper disposition. Including these amounts, total receipts were \$76,463,746. Of the forest reserve fund receipts, \$69,252,124 was from timber; \$4,415,862 from grazing; and \$1,064,482 from special land uses, waterpower, etc. Of the amount credited initially to the forest reserve fund, \$122,755 is returned to Arizona and New Mexico on account of State school lands within national forests and \$10,537 is derived from designated lands in the Superior National Forest for which special payment is made to the State in lieu of the usual 25 percent payment. Of the remaining \$74,599,176, 25 percent, or \$18,649,794, is paid to States for benefit of public schools and public roads of the counties in which

national forests are situated; also, 10 percent of the same base amount and of the \$10,537, or \$7,460,971 in all, is appropriated to the Forest Service for roads and trails within national forests. From the remaining balance there is appropriated \$45,332 for payment to Minnesota on account of the designated area in the Superior National Forest and \$531,000 from grazing receipts of various national forests for range improvements on such forests.

Expenditures for national-forest operation, protection, and management were \$39,885,879. Additional expenditures from appropriations for forest roads and trails amounted to \$24,532,516 and for acquisition of national-forest land \$121,969.

Aid to States

Forest Service expenditures for cooperation with States and private agencies in fire control, planting, and assistance in forest practice were \$10,667,198.

Research and miscellaneous

Expenditures for research were \$5,415,908 and for flood control \$1,307,562.

A total of \$8,594,947 was also expended for fire control, slash disposal, improvement work, timber-stand improvement, and other work financed by outside agencies and from receipts authorized to be expended for specified purposes.

Services for other Government agencies from funds advanced or transferred by such agencies amounted to \$2,533,134, including \$173,673 for the Department of the Interior, \$1,365,508 for the Army, \$354,154 for the Air Force, \$240,366 for the Navy, \$176,453 for the Department of Commerce, \$131,660 for the Production and Marketing Administration (Agriculture) and \$91,320 for other agencies.

Total net expenditures were \$93,059,113. In addition, expenditures for which appropriations were reimbursed amounted to \$6,517,989. Expenditures were accounted for by objective and functional classifications under 88 separate appropriation titles.

The Forest Service handled the naval stores conservation program, involving payment to farmers of \$532,522 from funds of the Production and Marketing Administration.



